

# Beginners' Artificial Intelligence & Python Programming

For Primary and Junior Secondary Schools  
(GRADES 4-8)

Olubayo Adekanmbi



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FOR PRIMARY AND JUNIOR SCHOOLS





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**Beginners' Artificial Intelligence a**

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## GLOBAL REVIEWS

"Bayo Adekanmbi is a passionate communicator of his book for beginners explains many key concepts of style and engaging illustrations that speak directly to basic principles of the Python programming language. He also provides more about future opportunities in data science and the tools they need to use."

Professor Alan Barnes  
of Cambridge's Global

"Artificial intelligence with python programming does it is completely possible, as presented beautifully validated in the real-world successes that this book here is perfect, by first introducing interesting, useful and use cases. This goal-oriented style will motivate with the combined power of AI and coding. This is growing into this intensely digital and massively complex student should study this book!"

Dr. Kirk Borne, Principal Data Scientist and Data Scientist at NASA

As we embark on the uncharted Fourth Industrial Revolution, contributions will come from Nigeria, Africa, or the

Contributions will come from Nigeria, Africa, or the book provides one crucial pathway. Focusing on young entry by creating a level playing field for girls a programming and other nuances of AI. Furthermore appropriate illustrations makes it easy for them to understand the underpinnings of coding. Thus, we can envision how AI can be used to transform societies and improve lives of the vulnerable.

**Dr. Uyi Stewart, Executive Director, Africa Data & Analytics**

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"Artificial Intelligence (AI) is no doubt changing the world around us. From natural language processing, AI is fundamentally changing everything around humanity. From adapting to natural language processing, AI is fundamentally changing everything around humanity. At the same time, virtually every economic sector is being transformed by AI. Emerging technologies like AI are changing every citizen including children and must learn code at an early age to build logical solutions to future problems. Olubayo Adekanmbi's book, *Begir Programming*, is just the right Africa needs now."

**Prof Bitange Ndemo - Professor  
and Chairman Blockchain Africa**

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"AI is the most transformative technology of our time and used by many across the world. Ideally, kids can express their ideas about the future. This book is an excellent way for them to understand AI and take their first steps with this exciting technology."

**Dr. Richard Socher**



## GLOBAL REVIEWS

"As smart technology entrepreneur and AI expert the purpose to help shape a better future in the Smart Africa, I highly recommend this excellent book founder of Data Science Nigeria, to introduce kid Intelligence and stimulate their curiosity to learn content presented in a very accessible, visual, and also build an application-focused mindset. This book democratizing AI on the African continent and beyond."

Dr. Jacques Ludik - Founder & MD, Cortex Logic

"Reskilling and relearning are critical ingredients for Artificial Intelligence. Starting early will definitely be a game-changer for Africa. This book, *Beginners' Artificial Intelligence and Python for Africans* now. The book is presented in a very conversational fashion to simplify AI and Python programming. This book will make Africa ready to compete in the fourth industrial revolution."

Brigette Hyacinth- Thought Leader in  
and Data Science

"One day cars will drive themselves. You will use them to travel."

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today. Wouldn't that be cool?

"But wait," I hear you say. You don't just want want to CREATE them? You hold in your hands the Python Programming book. It will guide you through two tools that you'll need to CREATE those future programming. As you work through this book, you that those magical technologies would be invented part of that ambitious dream!

**Ulrich Paquet. Co-founder, Deep Learning Ind**

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"Artificial Intelligence, the technology that will define our world, is often seen as a domain best left for experts or superpowers. In this formidable book, Olubayo Adekanmbi proves that AI can be taught to children in Africa. This book shows that AI benefits everyone and no book that achieves this like 'Beginners Artificial Intelligence and Python Programming'.

**Karim**

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There is a palpable sense of urgency required for Africa to catch up with the Fourth Industrial Revolution by urgently and greatly enhancing its education system (through upskilling its people) in all the exponential technologies. This book, 'Beginners Artificial Intelligence and Python Programming for Secondary Schools', by Olubayo Adekanmbi, is going to go a long way in building the capacity in AI, for African children, right from the earliest stages of their education.

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## DEDICATION

This book is dedicated to my darling wife, Toyin, who has been instrumental in supporting me through the challenges of writing it; to our children, Bolu and Folu, whose love and support have been a constant source of motivation; and to all the people who have contributed to the success of the book, including many friends, partners, sponsors, advisory board members, and the Science Nigeria staff, who passionately go the extra mile.

## PREFACE

The years 2015 and 2016 formed a major milestone in my life. I left my full-time work and undertook academic research to complete my PhD. I also required frequent trips to many emerging markets to work on a science project that focused on bandwagon social computing. One of the key take-aways for me was the huge potential in emerging markets to accelerate development through technology. I realized that we can accelerate tech-enabled development through AI in high-impact areas of social good. This was the beginning of my passion for AI, which I pursued through a non-profit I started about three years ago.

As the realities of the Fourth Industrial Revolution become more apparent, it is clear that AI will be the basis for national competitiveness. Hence, it is important for Nigeria to be the first society in which artificial intelligence is effectively deployed, particularly in addressing the country's sustainable development challenges. The established fact that AI can and will provide a significant contribution to the

enhancing how we live, work and play.

By creating pervasive knowledge across the country, Nigerian to build the skills of the future. I believe with its median age of about 18 years, is a huge opportunity for Nigeria as one of the top 10 AI knowledge centres in the world. We must re-tool and reskill our young ones with relevant skill sets through foreign exchange inflows, AI-enabled start-ups, and more. This will greatly benefit the lives of our citizens, train as data scientists and artificial intelligence specialists.

This book is an effort towards AI knowledge demystification. It aims to introduce artificial intelligence in a friendly manner to our students, teachers, parents, and the general public, curious about AI. The book starts by introducing the core concepts including machine learning, deep learning, and then introduces step-by-step programming using Python. My intention is to go beyond the traditional code-and-run approach, helping them to understand what the knowledge of AI is, as a way to build an application-focused mindset.

I appreciate all the friends, sponsors, advisory board members, and the staff of Data Science Nigeria, who continue to support my efforts to promote the applications of AI for Nigeria's collective good. I also thank MTN and fellow kingdom labourers at TACEF.

Thank you, Mobolurin (Bolu) and Mofolusayo (Fola) for your support and encouragement throughout the writing and the codes, line by line, to ensure that the book is user-friendly and imagery relevant to the book's intended audience.



## Chapter 01

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In this chapter, we are going to learn

- ✓ what Artificial Intelligence, or AI, is;
- ✓ how AI is changing the world

Hello everyone!

In this chapter, we are going to learn about the wonderful world of

Yes! The world of AI is very exciting. In fact, it's changing the way we live. Do you know what AI is? It's a type of computer program that can learn and make decisions on its own. For example, have you ever used a self-driving car? That's an example of AI. Now, imagine if you could drive a car yourself? That would be amazing, right?



Now isn't that cool?



## Fun Facts

Did you know that there are cars that can drive themselves?

Cars that can drive themselves are called 'self-robocars' and they all use AI to do so.

Companies have been building and testing self-driving cars.  
In December 2018, a company called Waymo started using self-driving cars to give rides to people in the suburbs of Phoenix, USA.

People are excited about the many benefits that self-driving cars will bring:

- fewer accidents
- fewer traffic jams
- less fuel
- more time for people to do other things, like read or sleep in the car while the car drives them
- fewer traffic police are required on the roads because self-driving cars will obey the rules of the road.

Wow!

Self-driving cars sound aw  
I can't wait to ride in one

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## Chapter 01

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### What Is Artificial Intelligence?

We have learnt that self-driving cars are able Intelligence (AI)...but what does AI actually mean?

Techopedia defines Artificial Intelligence as:

'an area of computer science that emphasizes the work and react like humans. Some of the activities are designed for include speech recognition, learning

(source: <https://www.techopedia.com/definition/190/artificial-intelligence>)



### Applications of Artificial Intelligence

- Smartphones: When you use a smartphone

**Smartphones.** When you use a smartphone (Huawei), you are interacting with AI. Virtual on iPhones and Bixby on Samsung, use AI to uses speech recognition to answer questions. The virtual assistants on our smartphones are

Did you know that Siri not only helps you to manage your day-to-day life, but she also has a sense of humour, just like a human? Ask her a question and see what her answer is.

## Fun Facts

Can you remember the definition of AI? The definition is machines that 'work and react like humans'.

One of the ways that iPhone's virtual assistant is displaying a sense of humour. For example, if you ask 'Am I a robot?' she will respond with an answer like:

- 'Virtual assistants have feelings too.'
- 'The humanoid mind. You are inquisitive.'

You could also ask Siri, "Are you intelligent?" and she will respond with:

- 'I'm smart enough to know not to answer.'

• I'm smart enough to know how to do

• 'As intelligent agents go, I'm not too

## Chapter 01

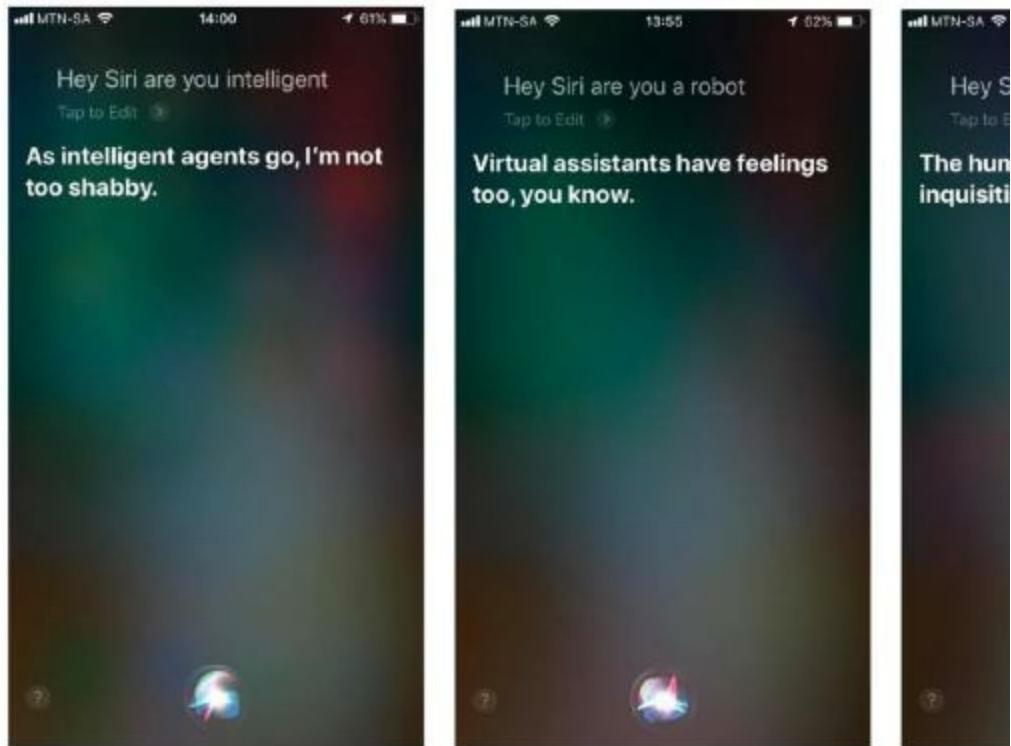


Figure 1:1 – Display screen showing how S

Ha, ha, ha!

Siri, you're so funny...for a n  
I thought you were huma

- **Video Games:** AI has been used in video games; a game such as Fortnite, you first play against real people. AI examines the human bot's responses to make the game realistic, e

Just in case you haven't heard of the term, a bot is a computer program that can perform tasks automatically. In gaming, bots are internet robots. In gaming, bots are controlled by a computer program.

But generally, bots are software applications that run on the internet for various purposes, including search engines like Google and Bing. They help search engines find the best deal on a particular product or service by interacting with human users.





## Chapter 01

- **Comfortable Living in Smarter Homes:** AI can live in more comfortable. Some people already have activated AI systems, such as Amazon's Echo, which can turn on lights and lock the doors.

Appliances, such as fridges, can be connected to the internet via a tablet. For example, if your mom went shopping and forgot something, she could use her smartphone to look into the fridge at home to see what is running low on, and then decide what to buy at the supermarket.

Mind-reading technology is also being developed to make our lives easier. One way is to control your home to control appliances, such as turning on lights or closing the curtains.

### Fun Facts

The AlterEgo headset is an example of mind-reading technology. It was created by a graduate student, Arnav Kapur, at Massachusetts Institute of Technology in the USA. It is a 3D plastic headset that you attach to your head.

When you wear the AlterEgo headset, you can control your home without touching it. You can turn on the lights, switching off the oven, ordering food online, and flipping through TV channels, all without saying a word.

While it seems as if AlterEgo reads your mind, it actually does not. Instead, it picks up tiny electrical signals that your face makes when you think about doing something.

picking up tiny electrical signals that your brain uses to talk to yourself. AlterEgo captures these tiny electrical signals and sends them to a computer that decodes them and then acts on them.

Unfortunately, AlterEgo is not for sale. It is still in development, and MIT is developing and refining.

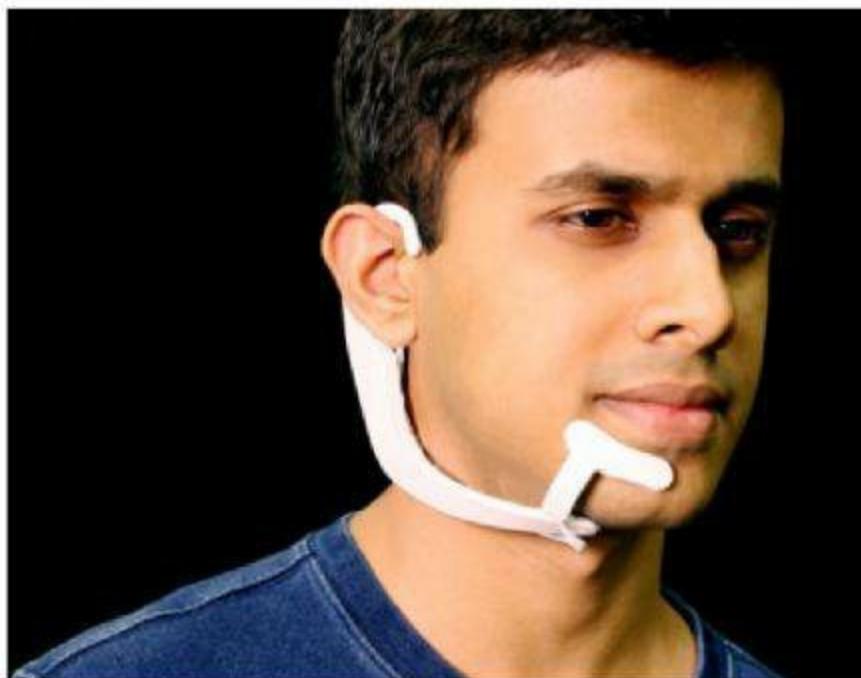


Figure 1:2 - AlterEgo headset worn by its developer

Source: MIT News

- **Better Healthcare:** AI is already helping us in healthcare. AI is helping doctors to quickly and easily diagnose patients. It is helping them to treat patients more quickly and save lives. AI can predict what health problems a patient may face based on the patient's genetic history, type of food they eat, their age, etc.

AI is being used to detect cancer in patient  
doctors decide on the best cancer treatment

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## Chapter 01

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Figure 1:3 - How robots use artificial i

Source: New York Time

- **Prediction of Natural Disasters:** AI can help us predict natural disasters like storms and earthquakes. AI systems predict data about storms, earthquakes and hurricanes to help us understand what is likely to happen next.
- **Entertainment:** Companies such as YouTube can recommend videos that you might like to watch based on your interests. In the future, however, it is quite likely that you will be able to choose from a wide choice of virtual actors.
- **Improved Policing:** AI is helping police to catch criminals. The police uses a facial recognition system that helps them identify people in photographs.

small portion of person's face. In Spain, an AI photographs from crime scenes and identify evidence in crimes.



Figure 1:4 - How Robot Police is being used

Source: Gulf News

- **Fraud Monitoring:** AI helps financial companies spot patterns in a customer's transactions, suspicious activity outside of the customer's banks can protect their customers against theft.

Well done!

I hope you've enjoyed learning about

*Artificial Intelligence!*

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## Chapter 02

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In this chapter, we are going to learn about:

- ✓ patterns in AI.
- ✓ how AI uses patterns to make predictions.
- ✓ how AI learns from pattern and the past.

Join me and let's explore the wonderful world of patterns and predictions. This learning from what has happened in the past to predict what will happen in the future.

I can think of a pattern right now! I remember

and Grade 6 play football, there is a pattern. Can you know why? The Grade 5 football team always play their games with their main goalkeeper, Adaeze, at the same time. This is held on the old school pitch.



Everything around us seems to follow a pattern, and especially regarding what has happened in the past and the future. Here are some amazing patterns that we can observe:

- The months when it tends to rain most are usually between April and September.
- It always gets dark at around 6:30pm, and comes back to life at 6:30am.
- The daily news on radio and television tend to repeat at the same times (e.g. 7pm and 10pm).

Patterns are everywhere around us. For instance, we usually prefer to take the shortest distance possible to get from one place to another. We also know how Google seems to know which is the best route to take. When people use Google Maps to navigate, it keeps a record of the routes taken and the time taken. As such, over time, Google Maps starts to learn the patterns of different routes. So, if you want to find the best route to take, just type in your destination and let Google Maps do the rest.

patterns of different routes. So, if you want to ...  
Google Maps knows which route is likely to have the  
and quickest way to get there.

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## Chapter 02

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Figure 2.1 – How Google Maps learns from us  
Source: UK Daily Express

### Fun Fact

Scientists have shown that the average person blinks up to 1,200 times per hour and a whopping 28,800 times per day, more than we need to keep our eyeballs lubricated. In fact, we spend about half of our waking hours with our eyes closed.

Wow! Everyone and everything we see everywhere has a sequence of patterns and if we understand them, we can predict what is likely to happen and that is what AI does so well!



As you can see, there are patterns everywhere. It is important to notice examples of patterns in our everyday lives. There are many patterns around us.

## How Can a Machine Learn These Patterns

Bassey, a grade 6 student, had plenty of action figures. He liked to play with them, but he always lost them. One day, Bassey noticed that his little dog, Lynda, was always hiding his action figures in the same place in Lynda's bedroom. Bassey was happy each time he found his action figures. Bassey had a habit of hiding them in a place where Bassey could not find them. Bassey decided to build a robot to help him find his toys?



## Chapter 02

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Figure 2:2 – How robots can help E  
Source: My Real Domai

1. At first, the robot will have to learn what Bas shows the robot pictures of toys and then show them to the robot. When we do this, we say we are training the robot.
2. Also, we will train the robot to look for toys by the wardrobe and in the closet.
3. Finally, we will do a test to see if the robot can find the toy.

To make this more effective, if the robot succeeds. In many ways, the robot thinks just like a human. It times it looks in a place and finds no toys, it moves note where it has already looked. It will keep looking for the toys.

The robot will perform the same search, time and again. If toys are usually found in the same place, Lynda's robot goes straight to Lynda's bedroom and look under the bed because it has found toys before.

This process by which something tries to understand what it has been exposed to is called **LEARNING**. If a machine learns to do this, we call it **MACHINE LEARNING**!

Wow!

Machine Learning! So, for certain tasks, machines learn how to successfully perform them in the same way that humans can. That's why machines can now recognize faces, know what the weather is like, and what's happening all around it.



## Chapter 02

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This is how artificial intelligence works. To perform a task, like drive a car or play chess, a machine will need to carry out the same task over and over again. It needs to learn and identify patterns to help it accomplish the task. Once a machine or robot can perform a specific task in a certain way, we say that it is an AI system.

In the past, we have always given instructions to machines to perform specific tasks, but that is now changing. With AI, machines can learn like humans. This is because, as humans, we store information in our brains. AI is also able to help machines store information in their memory in ways that are similar to humans. With the help of sensors, machines can sense the environment around them, think, feel and then act based on the information they receive.

The way that we come to school to learn, and later go to work, is similar to machine learning.

Remember the first time you learned the numbers 1, 2, 3, 4, 5, etc. You learned them by listening to your parents, teachers, and then practising them yourself.

numbers. Even though we all have different styles it is still possible to recognise numbers written by different people. So how does a computer know how to recognise a number (also called digit recognition)? It's a bit like a intelligence program that can recognise the digits.

We will use a free online tool found at <https://machinelearningforkids.co.uk>

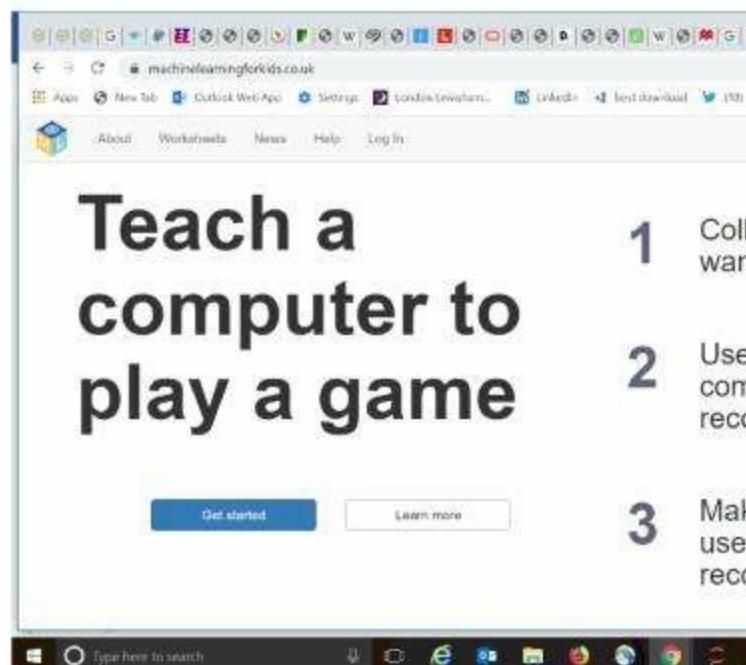


Figure 2:3 - How <https://machinelearningforkids.co.uk>

**Step 1:** In order to train our machine, we start by collecting training data. This means we collect many examples from people, then we group them. You remember that you learned new things by working through many examples. So, all the number 1s are grouped together, all the number 2s, and so on. The more examples we have (this is called training data), the better the machine will perform, and the more accurately it will be able to recognise digits.

Do you remember being introduced to a new topic by working through two or more examples. Similar to how we learn new things by working through examples to help us understand something new, a machine learning model learns to recognise handwritten digits by having many examples to work with.

their labels (in this case, what their number actually means). Let's look at the examples below.

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## Chapter 02

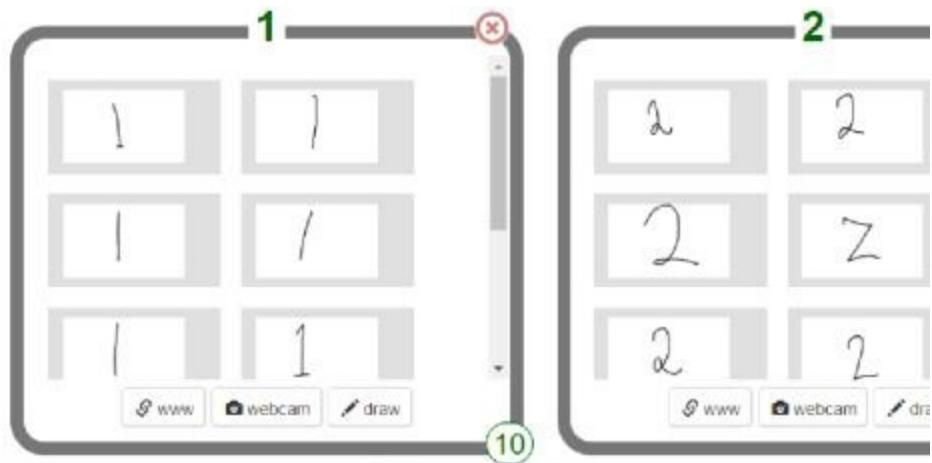


Figure 2:4 - Examples of handwritten dig

We collect as many examples as possible. The more examples we have, the more accurate the model will be.  
Do you know what ML stands for? It means Machine Learning.



**Step 2:** Training is a way to learn patterns by using knowledge for future actions or predictions. So, it will be time to test it.

We are going to write a number (between 0-9) and

WHAT NUMBER IT IS.

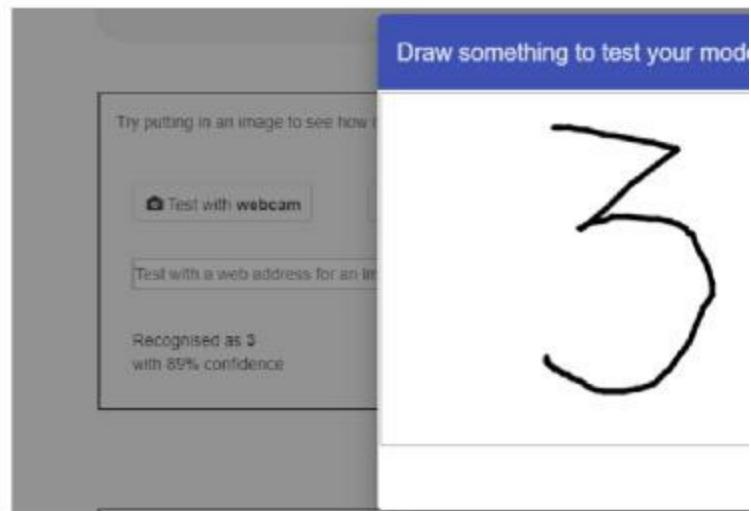


Figure 2:5 – Predicting handwritten

From the example above, our ML model was able to predict the handwritten digit correctly. That is a good level of confidence. Sometimes, however, the model is not confident enough and then we then help them learn more. It has only a 69% confidence score.





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## Chapter 02

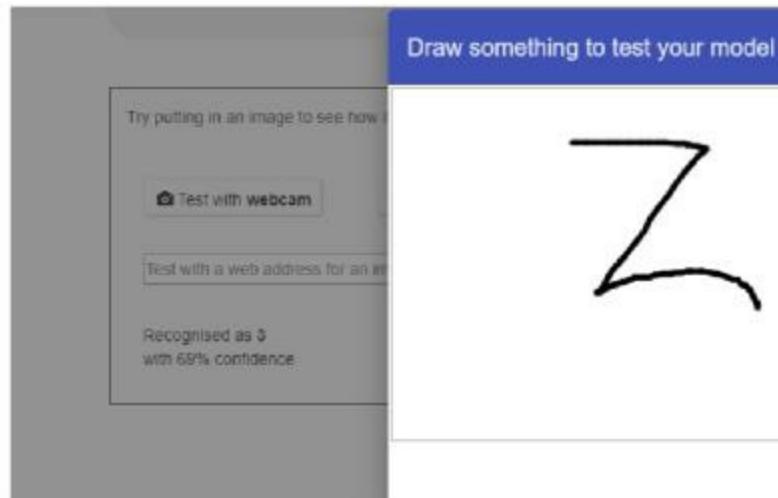


Figure 2:6 – Digit 2 wrongly recognised

Can we avoid the computer making mistakes? Yes! We always have to lots of accurate data as the more data the more accurate it will become

## Teaching Your Model

In the next example, let's say we want to teach a computer which books are good and which are bad. But the computer doesn't have access to the title and content of each book in order to identify them. Instead, we can tell the computer which books are inspirational and useful for learning by showing it many examples of books that are good ("positive examples") and some of which are bad ("negative examples").

For each category, we will also provide the computer with features that it can use to make its decision. These are called **FEATURES**. For example, a book may have the following features: its title, its author, degree of academic relevance, curriculum suitability, and whether or not it contains images.

Books	Known academic author	Degree of academic relevance	Curriculum suitable
Believe	Yes	Yes	
Powered to Succeed	Yes	Yes	
Fire-Fire-Fire	No	No	
Gra-Gra	No	No	
BlackED	No	No	
Chemistry 101	Yes	Yes	

Lyricious	No	No
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## Chapter 02

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Now that we have given the computer the training formula ('model') from it. The formula is like a special code in the data. With this special code, each time the computer sees new data, it uses the formula or model to decide whether the book is a YES or a NO.

The way the computer makes this special code or formula from the observed data is called **MODELING**. Let us explain how this works. Each point in the data has a number assigned to it ('weight'). If it is a YES, the weight is +1; if it's a NO, the weight is -1. The model then sums up the points for a book. This sum is called the 'score'. The model also has a cut-off: if the score is above the cut-off, the model decides it's a YES; if the score is below the cut-off, the model decides it's a NO.

**Summary:** As you have seen, people often can discover patterns simply by being a part of them. A machine learning model learns this same way. It looks at data and finds patterns in the information it is provided with (called training data). Once the model is trained, it can make predictions. For example, ML models can spot suspicious activity in your bank account or predict the weather based on the good or bad weather in the past.





Aha! I have learnt that almost everything follows a pattern. Because many things have it is easy for AI to study and learn from patterns, and then make prediction

## Questions and Answers

### Questions

- Is a computer able to spot objects in images?
- Do some things follow a pattern, or is everything random?
- Why are patterns so important in AI?

### Answers

- Yes, most objects have patterns and common patterns.
- Many living things, especially humans, have patterns.
- AI can use patterns to recognize other patterns.

I future.

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## **Chapter 02**

## References:





## Deep Learning: How AI Learns from Photos and Sounds



In this chapter, we are going to learn about:

- ✓ how AI can recognise peoples' faces and sounds.
- ✓ how AI uses sounds, photos, and video to understand the real world.

Join me on a journey to discover how AI can learn to recognize objects and patterns in photos, and sounds. Do you think a computer can detect different sounds like humans do?

Actually, yes. Just like people, AI machines can detect differences between a grown up dog's bark and a puppy's bark. This is similar to us being able to tell if it is our mother or father's voice even when we can't see their faces. Some of us can even hear the sounds of their footsteps, even when they are wearing socks! We can train a machine learning model to detect and identify different voices.



So, if AI can recognise content in photos, videos, and voices, what are some of the ways we can use this ability?



## Chapter 03

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Have you ever used a phone with a finger scanner? If you have, then this is a good idea. Because our fingerprints are unique, computers can use our fingerprints the same way we use passwords or PINs.

Also, just like fingerprints, our voice can be used to identify us from others. Fingerprints are being used as security measures. Can you think of other examples?





Identifying faces,  
like in the iPhone FaceID

That is very true. iPhones were the first smartphone to have a Face ID function. Did you know that these phones can also recognize faces in images? Now you can see the possible uses for AI as a medical tool. For example, AI can help detect skin diseases by studying patterns in many images of skin taken of normal skin and diseased skin.



## Chapter 03



If we can c  
we really n

### Fun Fact

Bal Gill, a 41-year-old woman, went to a tourist attraction called the Museum of Illusions in Edinburgh, that had a big thermal camera. Thermal cameras are common among tourists, and Bal was one of them. As Bal was going through the thermal images, she noticed a red heat map on her right chest area. She was concerned and went to the doctor. It turned out that Bal was diagnosed with an early stage of breast cancer. She was the first person known to have noticed the heat map, because thermal cameras are not commonly used in screening for diseases. Because of this, we may see more thermal cameras embedded in machines that can be used for medical purposes.



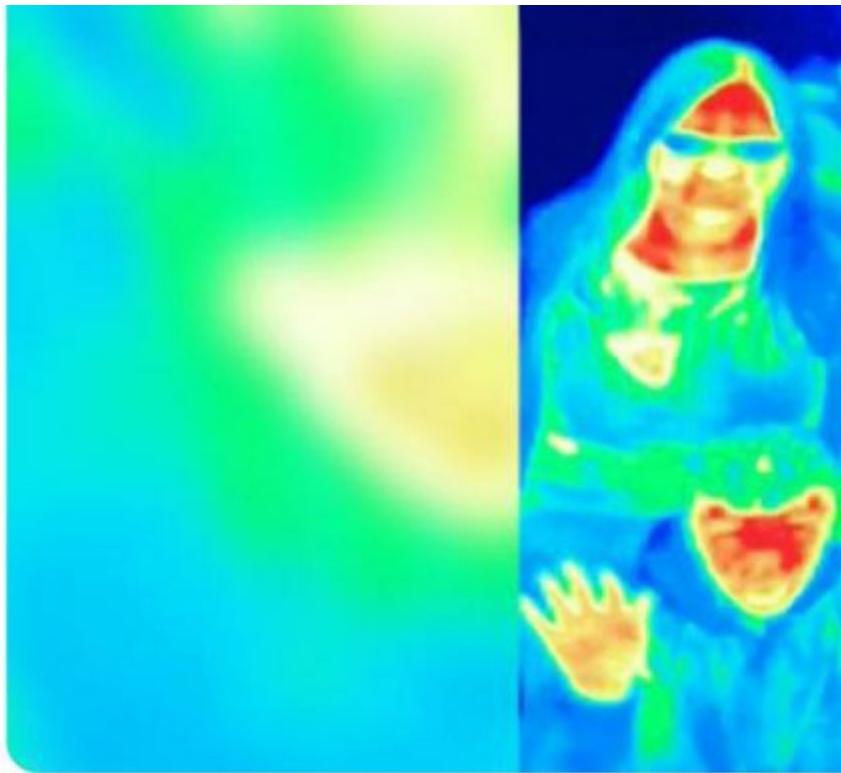


Figure 3:1 – Bal Gill image showing a heat map

Source: DailyMail.co.uk

So how does a computer recognise patterns in pictures? Well, it's all about numbers. That's because computers only deal with numbers. Yes, the images we see on screens, on computers, gadgets or our phones are all represented by numbers. This is because computers 'see' things in ways that we don't. They 'see' things in terms of 5-dimensional arrays of numbers.

I wish to know how it's done, how computers can recognise objects in images or video.



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## Chapter 03

Have you ever uploaded a photo on Facebook? Facebook suggests friends you can tag. In fact, it can identify faces of your friends from a photo. A good example of image recognition is the Face ID feature on an iPhone. You can ask your phone to, "Please show me all the photos of cats." The phone will recognise that you want to see photos of cats and will open your photo library app, showing you all the photos with cats in them.



### How Does Image Recognition Work?

You recall what we learned about patterns. Similar to how we recognise objects, an AI machine must be shown a large number of examples of an object and then identify what they all have in common, and then apply that knowledge to new objects.

in images it has never seen before.

With this, for example, we can build special machines that can identify a cat.



Cat

Figure 3:2 - Image of a cat

Source: Quora

There are certain principles you must learn about images. Computers don't see the images like we do because they only store images as **binary numbers**. This means that every image is actually a combination of 0s and 1s before a computer can interpret it.

Every picture that you see is actually a combination of small squares that we call **pixels**, combined in a special layout. If we change the position or color of some pixels, the image would definitely change.

Do you remember what you learned about the cell theory? A cell is the atom as the smallest indivisible part of matter. In the same way, images are made of small units (pixels), which can create unique patterns that a machine can interpret to recognize objects in images.

What a machine does with any image is to break it

- and store the colour code for each pixel as shown.  
cell of the matrix represents the **INTENSITY** of  
darkest shade of black), to 255 (which represents

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## **Chapter 03**

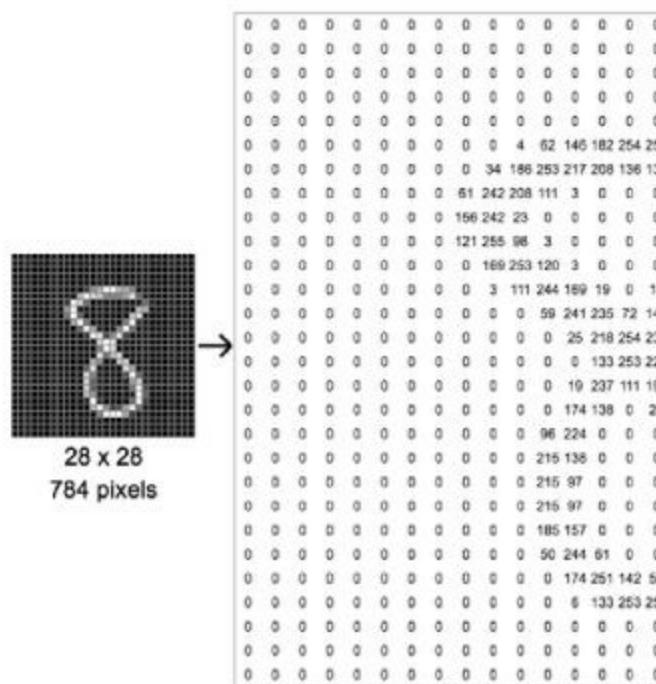


Figure 3:3 – A pattern of an image of numb

Source: becominghuman

## Activity 1: Image Reconstruction

We want to see how amazing the power of Artificial AI can go beyond identifying images and can actually be good at detecting human faces, we can use the Can you name a number of ways that this can be used?

For example, the famous app called FaceApp makes it possible to change your appearance. Do you want to know what you will look like in 20 years?



Figure 3:4 – FaceApp showing how Messi and Ro

Source: Sun News

Let us do more with an online tool by Nvidia available at

<https://www.nvidia.com/research/inpainting/selec>

**Step 1:** To show how AI can reconstruct an image from a damaged image.

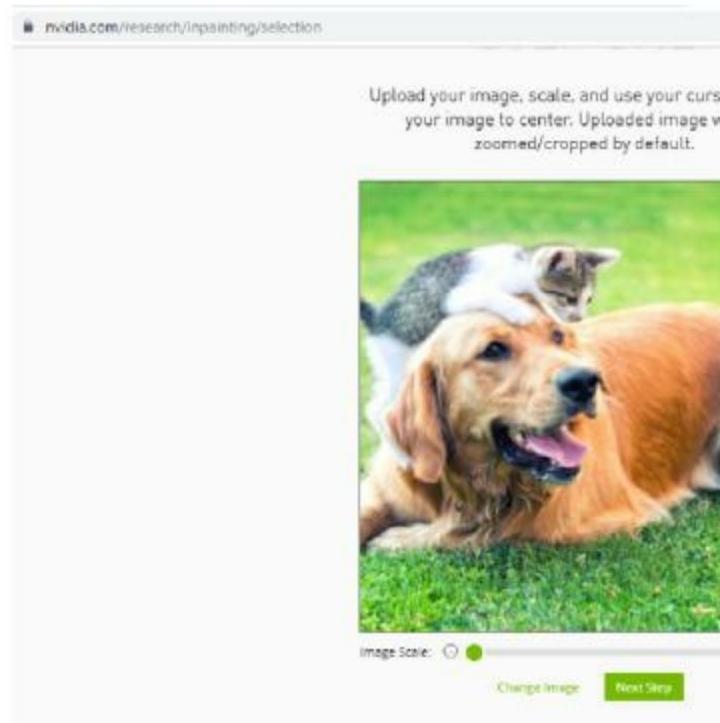
For this example, we'll use an image of a cat and a dog (<http://bit.ly/catplusdog>).

Click the link, and upload the image as shown below.

Then click **Next**.

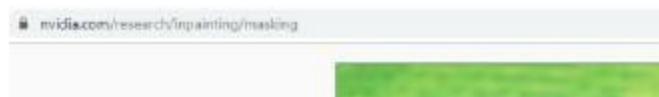


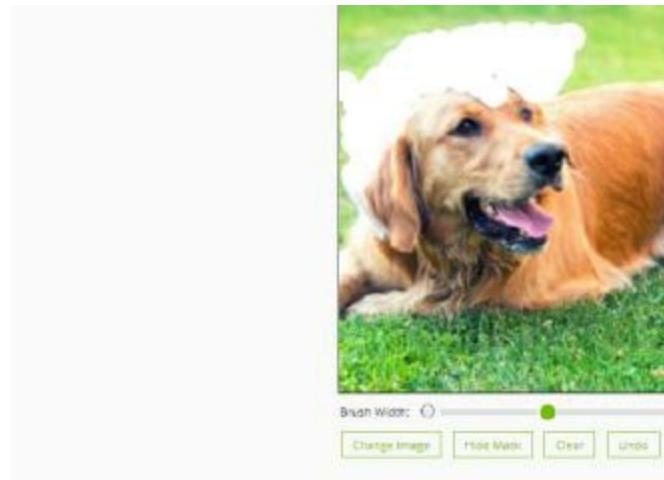
## Chapter 03



Click the link, and upload the image. N

**Step 2:** Using your mouse, click and rub out/eras  
Be careful to only erase most of the cat without  
Notice that the resulting image has an area colou  
for the AI model to try and reconstruct the imag  
the picture was taken.





*Cat object deleted from image*

**Step 3:** By clicking on 'Apply Model', the AI program will reconstruct the image by inpainting the hole in the background of the grass, and the outline of the dog's head was erased the cat.

We can see below that the AI program has reconstructed the image.



*Image reconstructed (Cat object added)*



## Chapter 03

### Activity 2: Parrot and Owl Classification /

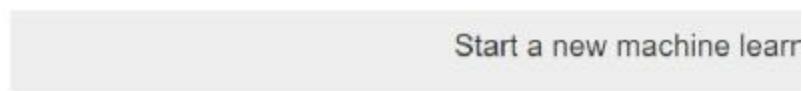
**Step 1:** In this activity, we will investigate how to identify a parrot and an owl.

In order to create your AI program, you need to visit <https://machinelearningforkids.co.uk>.

You will click **Get started**. Before you can **create** a project,

Click 'Add new project' and name the project **Parrot Vs. Owls Image Classifier**.

Next, select '**Images**' and click **Create**.



Whole-class project?

Project Name\*

Parrot Vs. Owls Image Classifier

Recognizing\*

images

*Image Classification*

**Step 2:** Select the project by clicking on it, and click **Train** to train our model. So click **Train** as shown in the image below.

## "Parrot Vs. Owls Image Classification Project"

### Train

Collect examples of what you want the computer to recognise

Train

### Learn & Test

Use the examples to train the computer to recognise images

Learn & Test

Use

*Training our model*

**Step 3:** Click **Add new** label and add labels, **Parrot** and **Owl**.

For this experiment, we can find images using [http://www.google.com/search?hl=en&q=parrot+image](#)

Please note that our model will yield better results if we have more images to learn.

Recognising **images** as **Parrot** vs. **Owl**

< Back to project

**Parrot**

www

webcam

draw

*Finding training data f*

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## Chapter 03

**Step 4:** Now that we have collected our data, we can start training the model.

Click on **Back to project** and select **Learn and test**.

Our model is now ready to train.

Simply click **Train new machine learning model** and wait.

Our model might take longer to train depending on the number of examples.

Remember, the more training data the model has, the better it will perform.

The screenshot shows a user interface for training a machine learning model. On the left, there's a large grey box containing text and bullet points. On the right, there are two smaller grey boxes with text. Below these is a blue button labeled 'Train new machine learning model'.

**What have you done?**

You have collected examples of images for a computer to use to recognise when images are Parrot or Owl.

You've collected

- 20 examples of Parrot,
- 20 examples of Owl

Ready to start training?

Click the button to start training your model. (Or go back and add more examples first.)

Info from training computer:

Train new machine learning model

*Training machine learning models*

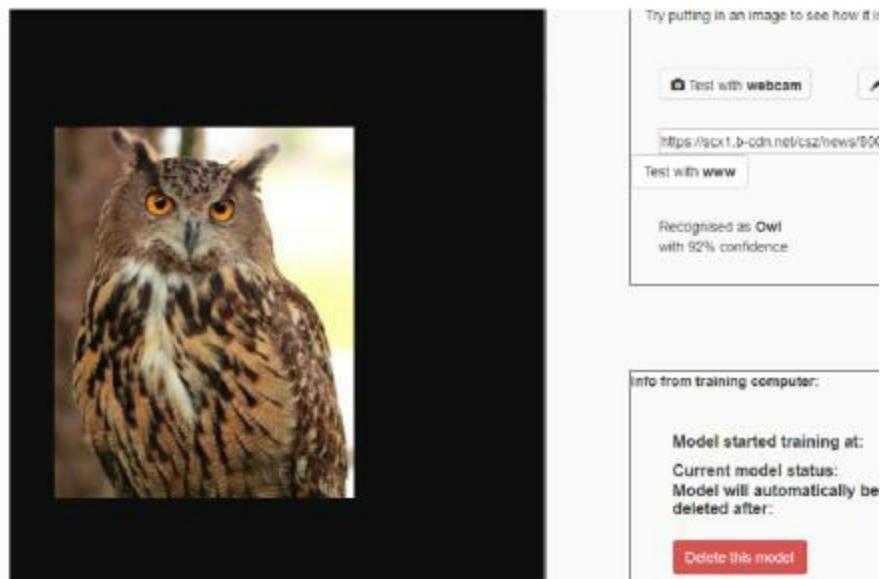
**Step 5:** After our model has been trained, we are ready to test it. Start by downloading or asking your friends for images that are different to the ones you have already used in the training set.

and click **Test**.

Our model should be able to recognise a picture of an owl.

Test your models using these two images.

As you can see, our AI model is able to correctly classify the image of an owl (<http://bit.ly/OWLtest>).



## Summary

Machines are able to represent images, or parts of images. With enough data, an Artificial Intelligence model can even detect an object in an image with multiple objects.

There are models that can look at your face and a person is happy, angry, surprised, disgusted or scared. Have you ever seen a Nigeria called AI Class Monitor? It's a special camera that subjects excite you most how often you react to them.

..... subjects you've had, how often you've even how often you have been dozing off in the cla

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## Chapter 03

I am really excited to know what AI can do to create a special robot that will help to detect diseases from photos taken of their faces. I can also generate voice done in local languages.



has been included in the book. I can do to cure diseases.

Thumbs Up!

The reason why we learn about artificial intelligence is that it can help us to detect potholes. I am going to create a special camera that takes pictures of roads so that I can learn the patterns of potholes. The camera will be able to identify roads likely to become potholes by detecting signs of wear and tear from the road surface.

This was a fun chapter. We have learned how to use ML to recognize images, sounds, and even text. There is a special type of machine learning that works on images called **DEEP LEARNING**. Yes, these programs are not shallow!



## Questions and Answers

### Questions

- Can machines recognize images? If so, how?
- Can you mention examples of image recognition?

### Answers

- Digital images are represented in computer memory as small collections of pixels. Programs can find patterns in these small collections of pixels and even classify objects in an image.
- Facebook suggests names so you can tag your friends in photos. An app can identify (recognize) your friends from their faces and suggest that you tag them in new photos that you take.

iPhones have a security feature, Face ID, identifying the owner's face.

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<https://victorzhou.com/blog/intro-to-cnns-part-1/>





## Chapter 04

R  
H  
O  
L

In this chapter, we are going to learn about:

- ✓ how AI learns from being rewarded for good results, and penalised for poor results,
- ✓ reinforcement learning in AI, and
- ✓ the current and future uses of reinforcement learning.



When we were very young and were learning to walk, we fell down. After several falls, we learned to walk. Our parents and other adults helps us walk. Each time we fall, we learn lots of things. However, when we did not fall, we did not learn lots of things.





I learned never to play with fire. When I was a child, my brother showed me how to put out a candle with just your hand. When I tried, I got burned by the flame. He mentioned that the trick was to do it quickly so that the flame burns your hand instead of you. It took me several attempts until I successfully learned how to do it. But when I did, my brother bought me a toy as a reward.

That is a very good example. Humans learn through reinforcement learning. Whenever we take a test, the teacher puts a minus sign next to the questions we fail and a plus sign next to the questions we get right. When we revise our wrong answers, we get more marks, and that is how we learn.

This is the same way an AI can learn through reinforcement learning. Did you know that an AI beat a world champion at the game of GO by using Reinforcement Learning?



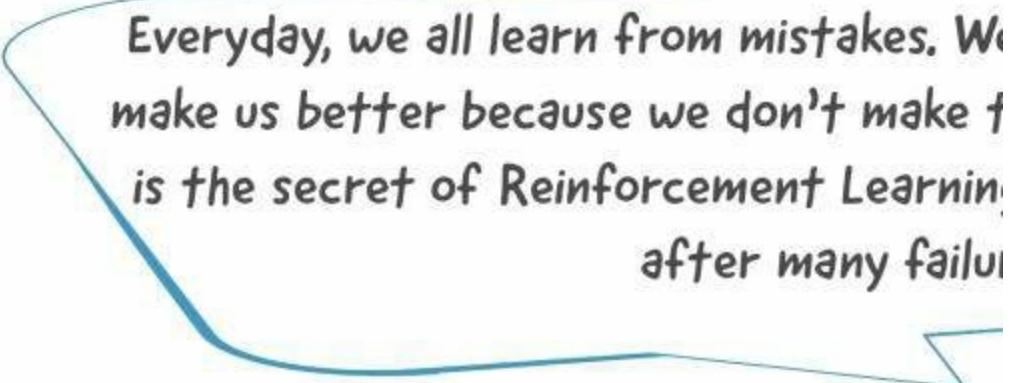


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## Chapter 04

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The game of Go is like Chess, but more complex, in the move counts. Just like Chess, it takes years of practice to become a world champion. Google trained an AI called AlphaGo using Reinforcement Learning, and was able to beat two world class Go professional players.



Everyday, we all learn from mistakes. We make us better because we don't make the same mistake again. This is the secret of Reinforcement Learning. It's not about getting things right after many failures.

### Fun Fact

Have you heard of a man called Jack Ma? He founder of Alibaba.com.

His is a story of trial and errors, as he learned successful. He failed primary school twice and failed his university entry exam three times. He even Kentucky Fried Chicken. He applied for Harvard and every time.

Now, he is one of the richest people in the world biggest e-commerce companies on the planet.

<https://www.ccamonash.com.au/articles/2018/1/2/jack-ma-a-story>

### How Do Machines Learn from Mistakes?

Let me start with an example. There was once a baby teddy bears in the cradle to play with. At one point she wanted to go to the toilet. All she had to do was get out of the cradle.

Halima tried climbing out of the cradle, but its side wall fell back into the cradle. She needed to step off the cradle.

Halima realised that if she stepped on one teddy bear's cradle's wall. She stacked the second teddy on top of the first one.

the top. Finally, Halima stacked all three teddy bears  
able to climb out of the cradle to go relieve herself.

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## Chapter 04

Just like what happened to Halima, in reinforcement learning, given a goal (get out of the cradle and go to the toy), to make progress, it has to start again (just as Halima failed to get over the side of the crib). However, if there is good progress towards achieving a goal, it is because of the reinforcement (the AI machine tries all means to reach the goal (Halima kept on stacking the teddy bears to climb out of the cradle and get to the toy)).



So in Reinforcement Learning, the AI explores the environment. The AI is free to try all new actions in the beginning. However, each time it fails, it learns. Over time it gets closer to the goal. The AI continues recognising it has made a mistake and tries again.



That's correct. Reinforcement learning is all about finding the best way to do something. It doesn't matter as long as the goal is met. For example, it could be used to manage the traffic lights in a town, and replace traditional traffic lights by reducing the time needed to travel through the town.



Why is RL different from other approaches of AI, and how can we best apply it?

RL is ideal when there is a big problem space with many possible states and millions of possible moves in Chess and many other games. For example, in Chess, it is difficult to define all the best moves. In such cases, it means we just let the AI robot play as many games as possible, and it will start to get better and develop its own strategy. RL is best used when there is a problem space that is too complex to be solved by traditional AI approaches.



## Chapter 04

The power of RL is because it learns patterns by punishment for every action taken; therefore, it is able to adapt to unexpected environments as it has learnt patterns.

Let's discuss how this is being applied in self driving cars.

Self-driving cars use many AI powered technologies without a driver. The car's AI analyses its surroundings and takes actions that are safe for itself, pedestrians and other vehicles. These cars are "autonomous", meaning they operate on their own without a driver.



Figure 4:2 - An example of sensors used in a self-driving car.  
Source: John P. Thomas

For a driverless car to work, it needs a lot of data.

understand patterns that can help it learn the best route to take, observe all the traffic rules, and make correct judgments about other vehicles and pedestrians on the road. To accomplish all this, the car uses sensors and cameras which collect data about where the car is and what is around it. This data is used by the car's computer to make decisions, such as how to respond to other vehicles or pedestrians, providing transportation without causing any harm to people or property.

## Reinforcement Learning by Adjustment

In RL, machines must be able to always adapt as they interact with their environment. In the same way we all had our first steps, we learnt to walk, we learnt to adjust our actions to achieve good results, such as learning to walk and not the punishment of frustratingly running into obstacles. Similarly, machines use reinforcement learning to determine the best course of action based on the feedback they receive from their environment.

For example, a robot will try different ways to achieve a goal. When it fails, it learns how to make future attempts better until the goal is achieved. Beyond learning how to walk, reinforcement learning can also be used to teach robots how to best to avoid obstacles or how to navigate through complex environments.





Figure 4:3 - An example of a robot t

Source: IEEE.org

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## Chapter 04

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Like our previous learnings, the more data we use error, the better it will become at achieving its goal of data, because it has to make a lot of mistakes right and achieve any set goals.

Reinforcement learning is used to solve many problems like automation, gaming development and other processes.

### Summary

Humans have always learned from their mistakes. When something does not work out, they change their approach. When something works, we get excited and repeat it. This principle applies to reinforcement learning as well. We keep trying and failing until it achieves the desired goal.

Have you ever been near a traffic light by a major and the traffic light on your route was red? You were no cars on the other roads leading through ti impatient and perhaps you thought that the red there were no cars passing in front of you. But your lights.

This is one of the areas where RL is sometimes used to specify rules for the traffic lights. AI enables the system to choose the best outcome, which is to show a red, green or yellow pattern and not based on the already pre-set timer.



**Figure 4:4 - An example of traffic li**

Source: NSW Australi

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## **Chapter 04**

I have learnt that reinforcement learning is a type of machine learning. A machine is given a specific goal. When it achieves the goal, it is rewarded. When it fails, it is penalized (it has to try to do better). Every time the robot makes good progress, it is rewarded. These back-and-forth activities form the basis of reinforcement learning. The machine uses to achieve its goal.



### **Questions and Answers**

#### **Questions**

- Why are rewards and punishments useful?

- Can you mention any application of reinforcement learning?

## Answers

- Because the machine learning model learns by trial and error. It tries different actions to reduce the mistakes it makes (punished) and rewards that help it to achieve its target goal (reinforcement).
- Apps are used in gaming, like playing chess, in training self-driving cars, and for training robots.

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## Chapter 05

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# Intr F

Now, we need to learn how to build our AI system starts by learning one of the most important languages in the world called Python. Python is popular programming language and it is easy to le

**In this chapter, we are going to learn about:**

- ✓ AI and Python
- ✓ what a computer program is;
- ✓ what code is;
- ✓ how to install Python on your computer
- ✓ how to write and save your first Python program.



### AI and Python

Wow, we have learnt so much!  
How is Python programming?



That's an excellent answer! Python is not only my favourite programming language, it is also one of the most popular programming languages in the world. Python is quickly becoming the top choice among programmers for its readability and ease of use. It is often used for AI projects. Read on to find out more about Python and how it can help you learn AI!

Python is an excellent choice for learning AI because it has a simple syntax and many built-in libraries that make it easy to work with data. It is also a versatile language that can be used for a variety of tasks, from web development to scientific computing. By learning Python, you will be able to work with large datasets and build complex models to solve real-world problems.



## Chapter 05

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Python is quickly becoming the top choice among developers because:

- Python involves **less code** than other programming languages and use.
- Python has many **prebuilt libraries** that are designed to save time when writing code.
- There is a lot of **support** available to developers. Python is open source (which means it is free) and there are many developers who are eager to help you.

### Fun Fact

Did you know that there are two types of pythons?

One type of python is a huge snake that grows up to 30 feet long and lives in Asia, Africa, and Australia. The other python is a programming language that is used by big companies like YouTube.

There is not much that you can do with the python snake except spot it in the wild. But there are a lot of super cool things you can do with Python the programming language.

## Understanding What A Computer Program

A computer program is a set of step-by-step instructions that follows to carry out a task. These step-by-step instructions in programming language known as **code**.

Do you remember how you give direction to your mom for the first time?

You use step-by-step instructions similar to how you get to school. You often use words like turn left, then go straight, then go to the end of the street...look for a building when you get to the traffic light, then turn right, then look for buildings from the right side of the road.

This is how computers work.



These codes are part of our devices and gadgets to help us do things.

- computer programs let you search for a contact (like a phone number) when you want to send a text message
- when you use your laptop or tablet, it is controlled by a computer program

play music, write documents, and search the

- the games that you play on your game console
-

## **Chapter 05**

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Computer programs also control many other pieces of equipment such as washing machines, televisions, cameras, and cars. For example:

- computer programs in some cars monitor and control the engine while travelling. They also monitor the temperature and level of fuel in the tank.
- computer programs in washing machines control the wash cycle.
- Have you observed an alarm that sounds when you leave your house? It is a program that has been instructed with codes to sound an alarm if a door or belt is not fastened. That is a program that is written in code.

**Note:** 'Computer programs' are often just referred to as 'programs'. You will often see the word 'program' in place of 'computer program'.

Software is a collection of computer programs, just as hardware is a collection of physical components. Just as you collect books or a forest of trees when you learn to collect, you can collect software when you learn to program.

### **What Is Code?**

When we develop a computer program, we write our instructions in a step-by-step logical order. These instructions tell the computer what to do. If there were no instructions, the computer would not be able to do anything.

These instructions are known as 'code', and the process of writing them is called 'programming'.

The instructions, or code, must be written in a programming language that the computer understands. There are many different programming languages available, such as Python, Java, C++, and JavaScript.

understands. There are many different programs the programmer chooses the best language for the

Have you heard of the programming languages Python, Javascript and Java before?  
Do you know what they are used for?

According to GitHub.com, which is a code-sharing website for developers worldwide, Javascript, Python and Java were the top three most popular languages in 2018.

- Javascript is used to build interactive websites and mobile apps.
- Python is a text-based language that is used for webpages, games, and the shells of computer operating systems. It is also used for machine learning.
- Java is used in the development of programs for mobile devices, enterprise applications, and video games.

Other computer languages ones include Ruby, PHP, C, C++, C#, and Go.

### Fun Facts

Python is an interesting name for a programming language. It's surprising to hear that it wasn't named after the snake. Python wanted to make it a program that was fun to work with.

very funny British comedy group 'Monty Python

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## Chapter 05

### How Do I Install Python On My Computer

What does it mean to install (or setup) of a computer program ready or usable for execution? The news is that Python software is easy to install so you don't have to ask your parents.

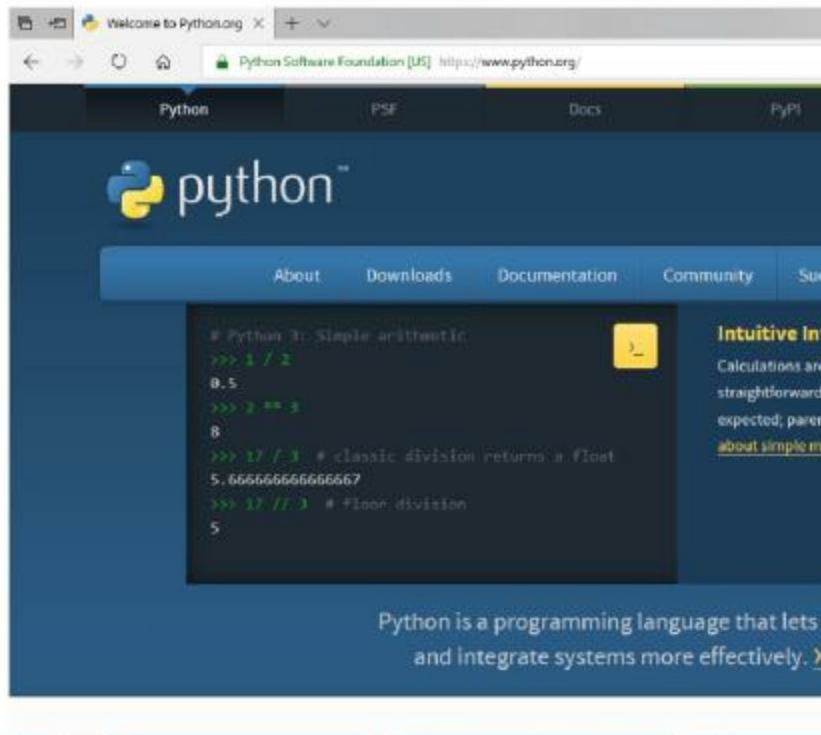


Follow these steps to install Python on your computer:

**Step 1: Go to the Python webpage**

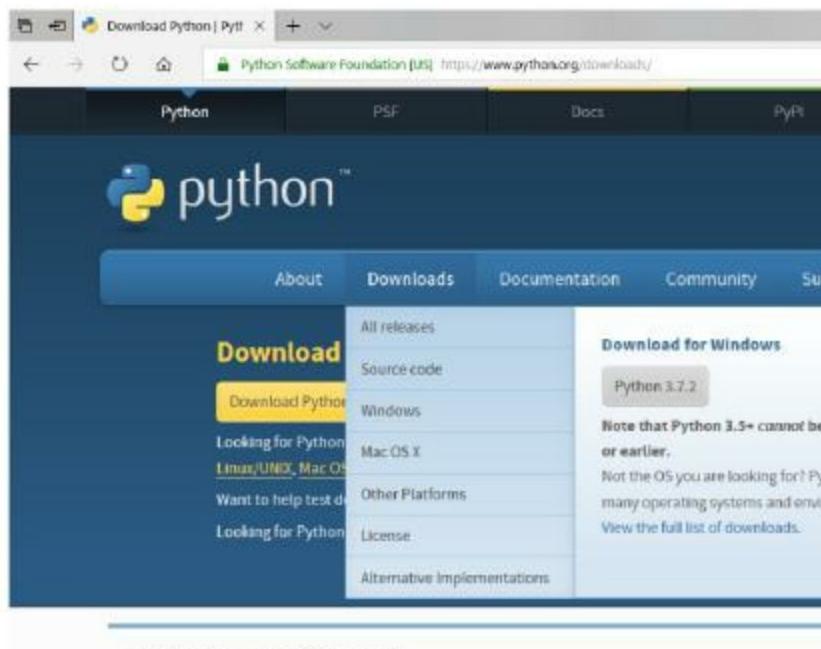
Go to [www.python.org](http://www.python.org) which looks like this:

www.python.org, which looks like this:



## Step 2: Go to the Python Download page

Click on the Download button.



Python releases by version number:

<https://www.python.org/downloads/>

Release date

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## Chapter 05

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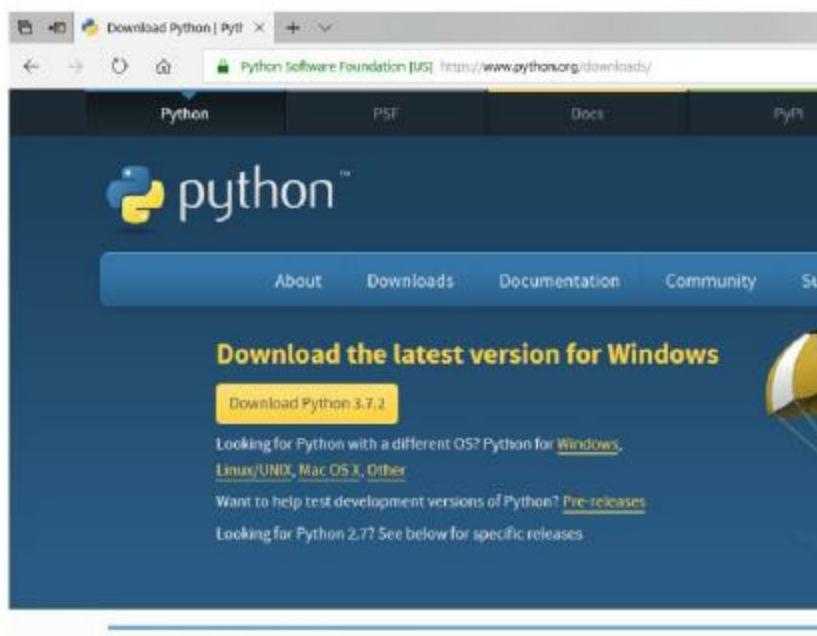
If the operating system on your computer is Windows, click on the **Windows** button you should see a **Download for Windows** link. If the operating system on your computer is not Windows, click on the **Other Platforms** button you should see a **Download for Other Platforms** link. If you click on the **Other Platforms** link you will see a list of other operating systems that you can download Python to (e.g. AIX, Solaris, Mac OS X, Linux, etc.).

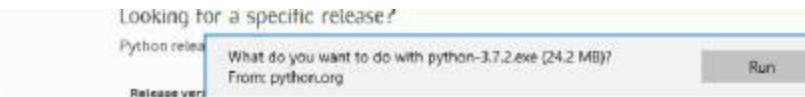
Steps 3 - 5 below show you how to install Python for Windows.

### Step 3: Download Python

On the Downloads page, click on **Python 3.7.2** (or the latest version available if it is shown in place of 'Python 3.7.2') and you will see the following screen. You will see a message on your screen asking, **What do you want to do with this file?**

Select **Run**.





**Note:** Only install versions of Python 3. Don't  
Installing Python 2 instead of Python 3 is like trying to  
ago! You will have definitely outgrown it!

#### Step 4: Install Python

The following screen, **Install Python**, will pop up.  
Be sure to first check (✓) the boxes at the bottom

- Install launcher for all users (recommended)
- Add Python 3.7 to PATH

Then click on **Install Now**.





## Chapter 05

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Python will start installing on your computer, and the progress bar will show you how far along it is.



Setting up Python will take a couple of minutes to complete.

Once the setup is complete, the following message will appear:





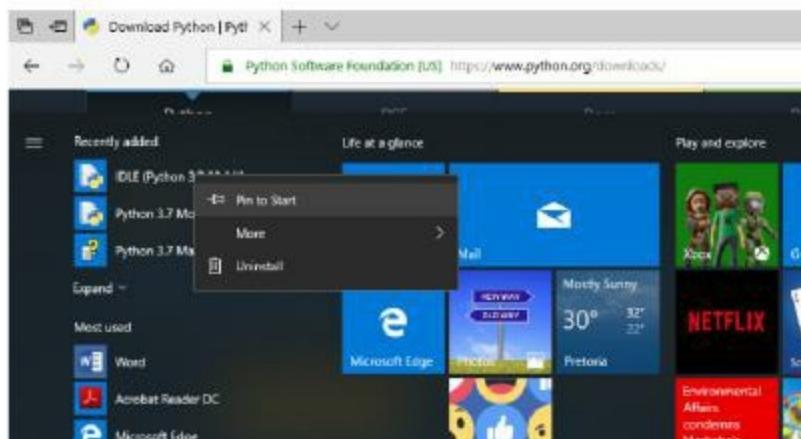
Click **Close**.

## Step 5: Create a Shortcut to the IDLE Python App

To make it easy to use Python, you need to pin the IDLE Python app to the Start menu. IDLE is short for "Integrated Development Environment" and is the app that helps you write Python programs.

To pin the IDLE Python app to the Start menu, open the Start menu and find the IDLE (Python 3.7 32-bit) app under the 'Recently added' section.

Right click on **IDLE (Python 3.7 32 bit)**, and select



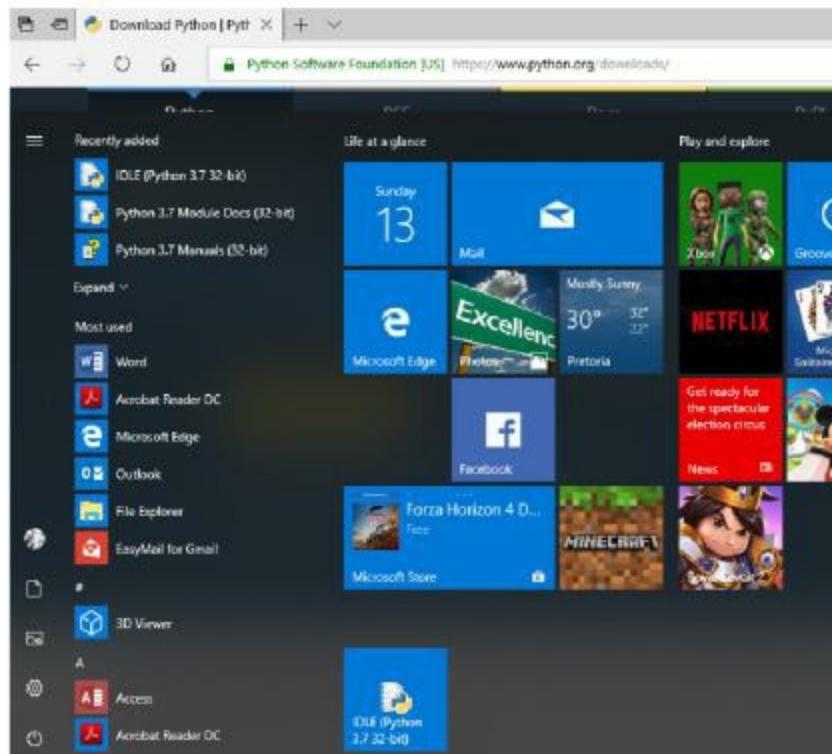


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## Chapter 05

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The shortcut to the app IDLE (Python 3.7) will appear in the Start menu. Click on **IDLE (Python 3.7 32 bit)** to open it.



## How Do I Write A Program Using Python?

To start using IDLE on a Windows computer, click on the IDLE icon. This will open IDLE.





This is what IDLE looks like when it opens:

```
Python 3.7.2 Shell
File Edit Help Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2018
ntel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> |
```



## Chapter 05

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Immediately to the left of the cursor (**I**) you will see the word > which is called **the prompt**. The prompt means that you can enter some command or code.

Let's enter some information. After the prompt, type:

```
print ("Hello World")
```

Make sure you include the parentheses () and the quotation marks " ".

Can you imagine someone's email address without the @ symbol? It would look something like this: name@something.com.

Any email sent without this format will not be sent. This is also true when you are writing codes in Python. You must use quotation marks in the right places.



The screenshot shows a window titled "Python 3.7.2 Shell". The menu bar includes File, Edit, Help, Options, Window, and Help. The main area displays the Python interpreter's welcome message: "Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Mar 25 2019, 14:52:54) [MSC v.1916 32 bit (Intel)] on win32". Below this, it says "Type "help", "copyright", "credits" or "license" for more information." A command line input starts with ">>> print("Hello World")".

Then press 'enter' on your keyboard and see what I Python says 'Hello World' back! Isn't that supercool

```
Python 3.7.2 Shell
File Edit Shift Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
formation.
>>> print("Hello World")
Hello World
>>> |
```

The word 'print' is an instruction that we give to write on the screen what we have written in the part "Hello World". The word 'print' is a type of Python command.

Any time you use these functions, the computer knows some single word commands that your parents or teachers taught us like stop, sleep, hop, stand, silence, and clap? and teachers to make us follow specific instructions.





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## Chapter 05

### Fun Fact

Hello World is the most famous computer program. It is the first program that is written by everyone who learns to code.

The Hello World program was first created by Brian Kernighan in 1973. Unfortunately, Mr Kernighan chose to use the words 'Hello World'. He thinks he saw with a picture of a chick and an egg, and

### How Do I Save My Python Program?

As a computer programmer, you will spend many hours writing programs. It is important that you save your programs so that you can run them later on.

Let's learn how to save Python programs by recreating the process of saving it. To do this:

- open IDLE, and click on **File**, and then select **New** from the empty window, with **Untitled** in the menu bar



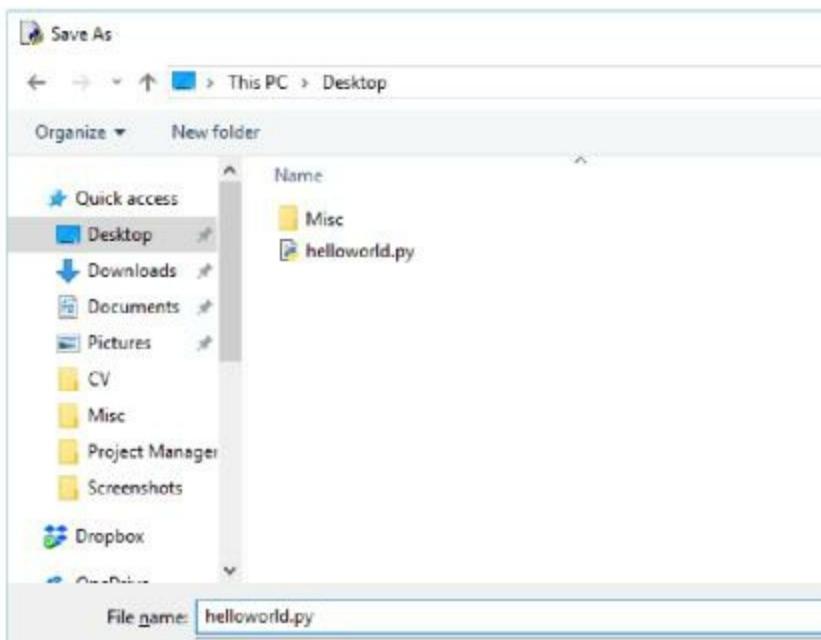
- Next, type the code for the Hello World program.



A screenshot of a code editor window titled "Untitled". The menu bar includes File, Edit, Format, Run, Options, Window, and Help. The code area contains the following Python code:

```
print("Hello World")
```

- Then click on **File**, and then click on **Save**.
- Then select Desktop or any other file of choice as the file name.
- Click on **Save**.



Save as type:

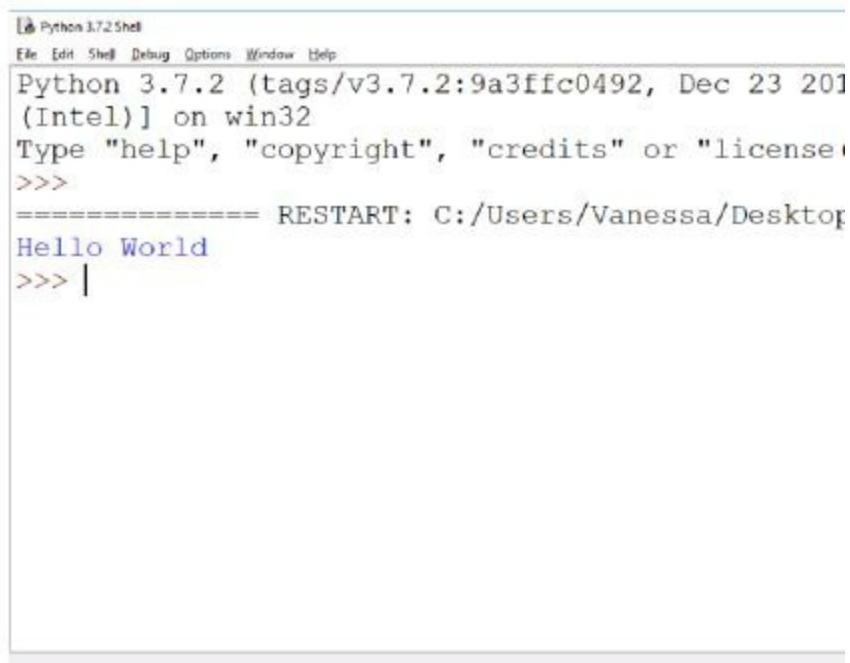
Hide Folders

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## Chapter 05

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- Now select Run, and click on Run Module. You



The screenshot shows a window titled "Python 3.7.2 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the following text:  
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 201  
(Intel)) on win32  
Type "help", "copyright", "credits" or "license"  
>>>  
===== RESTART: C:/Users/Vanessa/Desktop/  
Hello World  
>>> |

- 
- 
- References:**
  - The following sources were consulted in the preparation of this presentation:
    - Briggs, J.R. 2013 Python for Kids. San Francisco: No Starch Press.
    - Business Insider. 2018. The Ten Most Popular Programming Languages in 2018. Available at: <https://www.businessinsider.co.za/the-top-10-most-popular-programming-languages-in-2018-according-to-aithub-2018-10?r=US&IR=T>

HackerRank. 2015. The History of Hello World. | [hackerrank.com/the-history-of-hello-world/](https://hackerrank.com/the-history-of-hello-world/). [Accessed 10 January 2018].

Wired. 2010. Getting Started with Python. [ONLINE] Available at: [https://www.wired.com/2010/02/get\\_started\\_with\\_python/](https://www.wired.com/2010/02/get_started_with_python/).



## Chapter 06

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In this chapter, we are going to learn about:

- ✓ what expressions are
- ✓ doing Maths with Python
- ✓ fixing mistakes in Python
- ✓ what data types and variables are



In this chapter, we are going to learn about expressions, doing Maths with Python, fixing mistakes in Python, and what data types and variables are.



### Fun Fact

Did you know that at the end of 2019, Python wi

Python was introduced by a Dutch programmer  
though the first ever version of Python (i.e. Pyth

Guido now has a special title — the Python commu

Python programming is very popular. In fact, Pyt  
who used the Google search engine in the USA :  
searched for US President, Donald Trump, or th

Now, that is amazing!

## What Are Expressions?

I know that a smile or a frown is a faci  
expression... but I have no idea what an  
**expression** is in Python.



## Chapter 06

An expression is the most basic type of value in a programming language.

It consists of values, such as numbers. It also consists of operators like plus signs, minus signs, multiplication, and division.

Expressions are always evaluated, or reduced, to a single value.

This is the result of the expression.

Open up IDLE and type the following code:

in an empty file.



Once you have opened IDLE, type the following after the prompt:

`2 + 3`

Then press **enter** on your keyboard and see what h  
Python does the calculation! It adds 2 and 3 and c  
that cool!

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 19 2018, 19:16:32) [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license".
>>> 2 + 3
5
>>>
```

So, **2 + 3** is an example of an **expression** in  
a **basic instruction** which consists of **value**  
**2** and the number **3**) and an **operator** (the  
expression evaluates to a **single value** (**5**))  
the **enter** button on your keyboard



Value



---

## Chapter 06

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The operator for addition in Python is the same as the math symbol (+). The operator for subtraction in Python is also the same as the math symbol (-). However, for division and multiplication, Python uses different operators than the math symbols. The Python operator for multiplication is the asterisk (\*). The Python operator for division is the forward slash (/). We can use parentheses to change the certain order of operations, for example,  $(6 + 2) * 3$ . This follows your BODMAS or PEMDAS rule!

Math Symbol	Python Operator	Operation
+	+	Addition
-	-	Subtraction
×	*	Multiplication
÷	/	Division
$6^2$	**	Exponentiation
( )	( )	Parentheses

## Using the Python Shell to Calculate Math

The Python Shell allows us to do calculations in Python. Now, let's type out some expressions on math statements.

NOW, LET'S TRY OUT SOME EXPRESSIONS, OR MATH STATE

Open IDLE, and type in the following next to the p

Type  $6 + 2$

Then press **enter** on your keyboard. Python sh

Type  $6 - 2$

Then press **enter** on your keyboard. Python sh

Type  $6 * 2$

Then press **enter** on your keyboard. Python sh

Type  $6 / 2$

Then press **enter** on your keyboard. Python sh

Type  $6 ** 2$

Then press **enter** on your keyboard. Python sh

Type  $(6 + 2) * 3$

Then press **enter** on your keyboard. Python sh



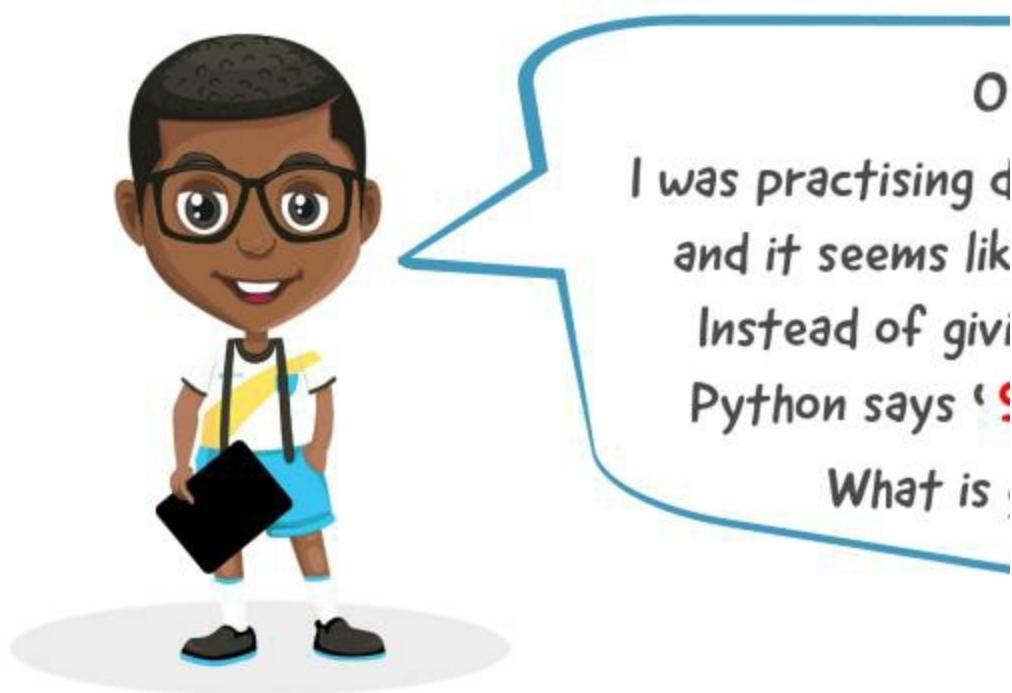
## Chapter 06

---

```
[Python 3.7.2] Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23  
2 bit (Intel)] on win32  
Type "help", "copyright", "credits" or "lice  
>>> 6 + 2  
8  
>>> 6 - 2  
4  
>>> 6 * 2  
12  
>>> 6 / 2  
3.0  
>>> 6 ** 2  
36  
>>> (6 + 2) * 3  
24  
>>>
```

Wow! Python is really good!  
From now on, I'm going to use Python for my maths homework!

## Fixing Mistakes in Python



O  
I was practising d  
and it seems lik  
Instead of givi  
Python says ' '  
What is

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2  
6 32 bit (Intel)) on win32  
Type "help", "copyright", "credits" or "lic  
. .  
>>> 8 + 7  
15  
>>> 8 - 7  
1  
>>> 8 x 7  
SyntaxError: invalid syntax  
>>>
```



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## Chapter 06

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Don't worry!

You made a simple syntax error. This happens just to kids like you, but also to experts. Remember that in Python, the operator for multiplication is an asterisk (\*), not a dot.

In language, syntax refers to grammar and the way sentences are well-formed and understandable.

In computer programming, syntax can be defined as 'the rules that specify the correct combined sequence of symbols'.

form a correctly structured program using a given  
(source: <https://www.techopedia.com/definition/3959/syntax>)

So, if Python gives you a syntax error, it is telling you something about the way you wrote an expression or statement. You need to identify what is wrong and then correct it. For example, if you write `print as 8 * 7` (which Python cannot understand), you might get an error message like:

Can you imagine a student writing this sentence, "I am going to go to school". He actually got all the five words in the sentence right, but the computer flagged it as an error. This type of error also happens when you misspell a word or forget a punctuation mark. It's just like when you are confused when someone makes an error in speaking. In both cases, the computer becomes confused and thus flags it as an error.

### Fun Fact

Python is a language, just like English and French. English and French are known as natural languages, because they are used by people to communicate. Python is known as a formal language because it was designed to be used by computers. Just like English and French, there are certain rules and grammar that need to be understood.

Did you know that in 2015, Python overtook French as the most popular programming language taught in UK primary schools? Sixty percent of primary school children chose to learn Python rather than French, according to their parents!

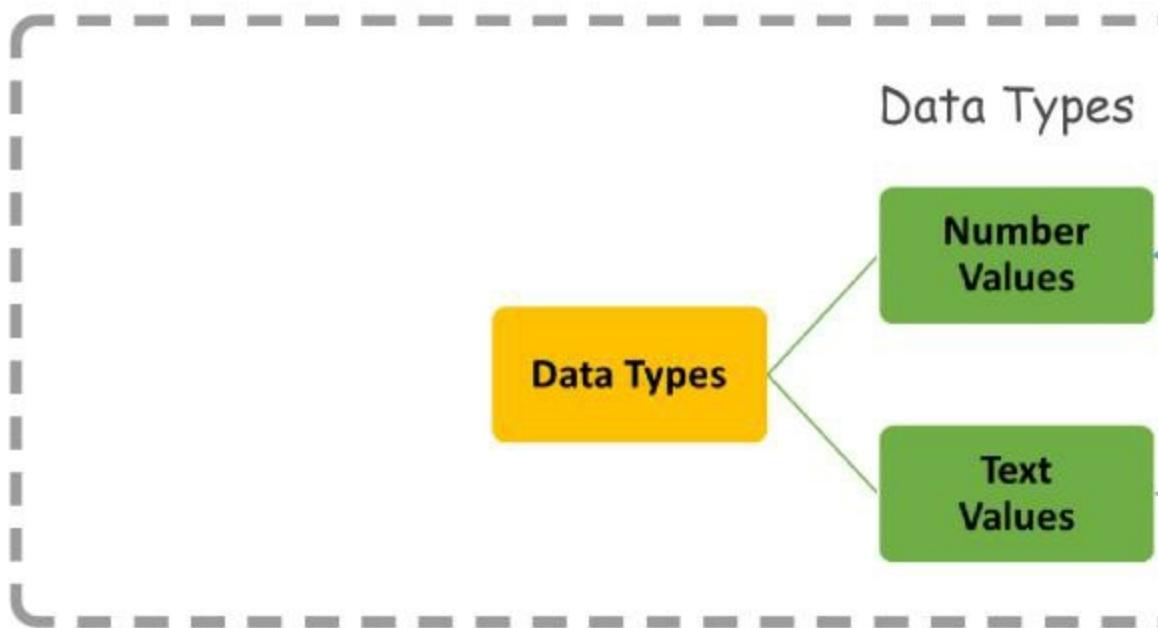


## Chapter 06

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### What Are Data Types?

All values have a **data type**. A data type is a category of one data type. Below is a diagram that shows the two main categories of data types.



### Integers

Integers are positive or negative whole numbers, In Python, integers are known as ints.

### Floating-Point Numbers

Floating-point numbers are numbers with decimals. In Python, floating-point numbers are known as floats.

While 3 is an integer, 3.0 is a floating point number.

## Strings

Text values are known as strings. For example, "three loaves of bread" are both strings. They are points. When typing strings, begin and end strings that Python knows where the text begins or ends (

### Activity I: Data Types

Hi, everyone! I have been asked to sort this data types. Can you help me, please? The data

“Peter”	-652
‘apples’	78
0.11111	“decimals”
1.0	‘numbers’
1	333.333

Please use the table below to help me sort t

---

## Chapter 06

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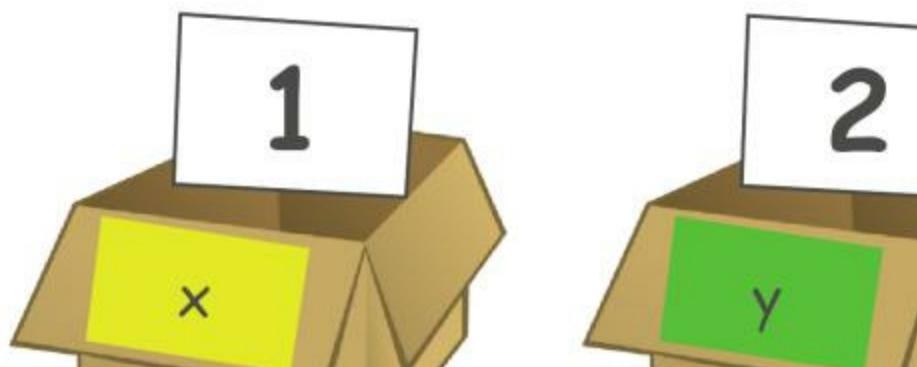
Help sort the data into the correct data type.

Integers	Floating-Point Numbers

(\*Note: The answer to this activity can be found at the bottom of the page.)

## What Are Variables?

Variables are where we store stuff in Python. A variable is a name for something that may change.



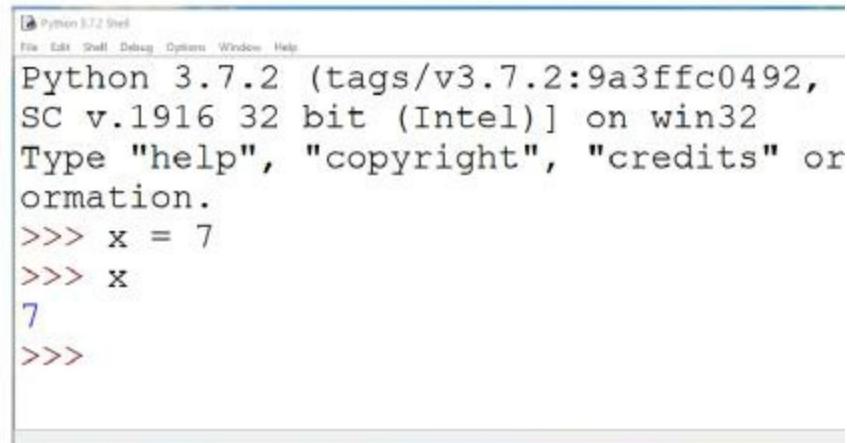


You can use variables in expressions anywhere that evaluates to the value it contains.

Let's store some variables in Python. Open up ID prompt:

Type **x = 7** and press **enter**.

Let's see now if Python remembers what **x** is. Python evaluates the expression and responds remembers that **x** is equal to 7.



```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, SC v.1916 32 bit (Intel)) on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>>
```

Now type **y = 2** and press **enter**.

To see if Python remembers what **y** is equal to, Python evaluates the expression and responds w equal to 2!



## Chapter 06

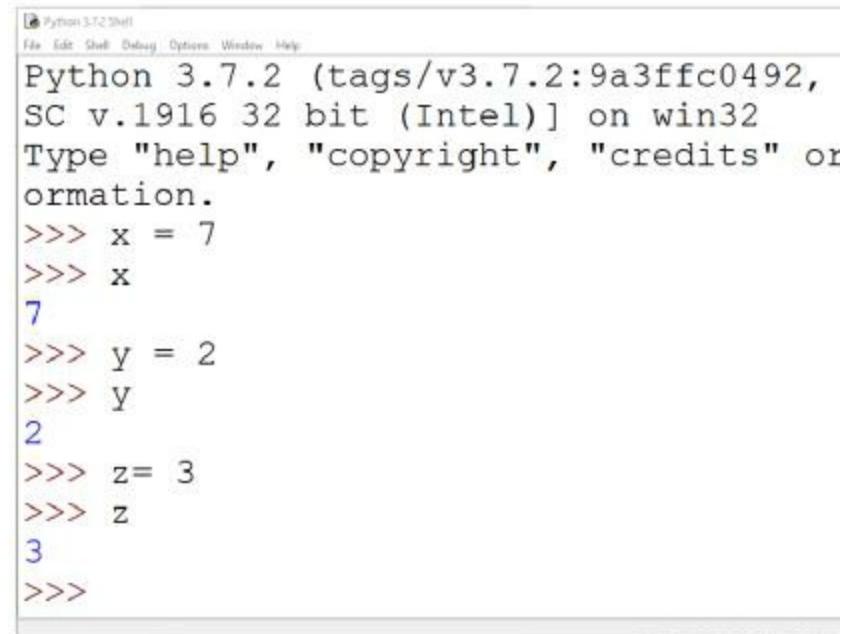
---



```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, SC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>>
```

Now type `z = 3` and press **enter**.

To see if Python remembers what `z` is equal to,  
Python responds with **3!**



```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, SC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>> z= 3
>>> z
3
>>>
```

Python has remembered that `x = 7`, `y = 2`, and `z = 3`.

Python has remembered that  $x = 7$ ,  $y = 2$ , and  $z = 3$ .

These values have been stored and we can re-use them.

For example:

- Now type  $x + y + z$  and press **enter**.
- What does Python do? Python tells us that  $x + y + z = 12$ .
- Now type  $x * y$  and press **enter**.
- What does Python do? Python evaluates  $x * y = 14$ . Python remembered that  $x = 7$  and  $y = 2$ .

Now type  $(x + y) / z$  and press **enter**.

Python does the calculation and responds with  $(x + y) / z = 5$ . In this calculation, Python first added the  $x$  and  $y$  (the value of which is 9) and then divided that result by  $z$  (the value of which is 3) to get 9. Python then divided 9 by  $z$  (the value of which is 3) to get 3. Python then divided 3 by  $z$  (the value of which is 3) to get 1. Python then divided 1 by  $z$  (the value of which is 3) to get 0. Finally, Python divides 0 by  $z$  (the value of which is 3) to get 0. So the final answer is 0.

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 6 2018, 19:16:32) [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>> z= 3
>>> z
3
>>> x + y + z
12
>>> x * y
14
```

```
|>>> (x+y) / z  
|3.0  
|>>>
```

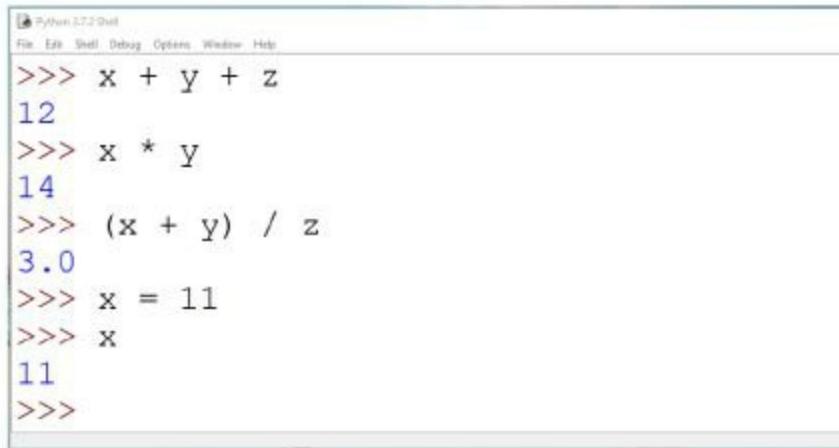
---

## Chapter 06

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If you need to change the value of any variables for example, if  $x = 7$  is no longer relevant, and you need to do is:

Now type  $x = 11$  and press **enter**. To check that **enter**. Python responds with **11**. This confirms the change from 7 to 11.



A screenshot of the Python 2.7.2 IDLE interface. The menu bar at the top includes File, Edit, Shell, Debug, Options, Window, and Help. The main window shows a command-line session:

```
>>> x + y + z
12
>>> x * y
14
>>> (x + y) / z
3.0
>>> x = 11
>>> x
11
>>>
```

### Activity 2: Variables

For this activity you need to:

1. Open IDLE

2. Define values to variables as follows:

- $x$  must have a value of 9

- y must have a value of 7
- z must have a value of 23.

**3. Once you have defined these values to x, y, and z, you must calculate the following:**

- add x and y
- subtract y from z
- multiply x and z
- divide z by y.

(\*Note: The answers to this activity can be found below.)

### Solutions for Activity 1:

Earlier on in this chapter, you were asked to

The correct answers to this activity are:

Integers	Floating-Point Numbers
1	0.11111
-652	1.0
78	333.333

L

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## Chapter 06

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### Solution for Activity 2

*Below is a screenshot, showing the*

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23
32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lice
>>> x = 9
>>> x
9
>>> y = 7
>>> Y
7
>>> z = 23
>>> z
23
>>> x + y
16
>>> z - y
16
>>> x * z
207
>>> z / y
3.2857142857142856
>>>
```

Well done!

You are well on your way to  
rock star programm

## References:

- The following sources were consulted in the preparation of this presentation.
- Payne, B. 2015. Teach Your Kids to Code. San Francisco: No Starch Press.
  - Rossi, B. 2015. Python overtakes French as the most popular language taught in primary schools. *Information Age*. [ONLINE] Available at: <https://www.information-age.com/python-most-popular-language-taught-primary-schools-12346> (Accessed 17 July 2019).
  - Sweigart, A. 2015. Automate the Boring Stuff with Python. San Francisco: No Starch Press.
  - Stichbury, J. 2018. 5 Facts About Python. Big Data. [ONLINE] Available at: <https://dzone.com/article/5-facts-about-python> (Accessed 17 July 2019).
  - Techopedia. 2019. Syntax. [ONLINE] Available at: <https://www.techopedia.com/definition/3959/syntax> (Accessed 17 July 2019).
  - Wentworth, P., Elkner, J., Downey, A.B., and Meyers, C. 2019. How to Think Like a Computer Scientist: Learning with Python 3. Document Foundation.



## Chapter 07

---

In this chapter, we are going to learn:



- ✓ what a string is
- ✓ what a list is
- ✓ what a tuple is
- ✓ what a dictionary is



In this  
learn al

## Fun Fact

Did you know that Python and Google are good friends? Python is an official programming language that is used at Google. It's an easy language to use!

Python powers a number of Google products, including Google Sheets. That's so cool!

Do you remember what did we learn about in previous chapter?

## What is a String?

String can be described as a collection of key characters enclosed within quotation marks. The characters can be single quotation marks (' ') or double quotation marks (" "). When we type a string in Python, Python will simply give us back what we typed.

Open IDLE, and type the following after the prompt:

'5 + 5'

Then press `enter` on your keyboard and see what happens.  
What do you notice? Python simply gives us back ''

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## Chapter 07

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```
[Python 3.7.2 Shell]
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits"
information.
>>> '5 + 5'
'5 + 5'
>>>
```

Now that's interesting! So, when we place numbers between quotation marks, Python does not do anything with them. It just gives us back the text.

Now, let's remind ourselves what happens if we type numbers without quotation marks. Type **5 + 5** into IDLE without quotation marks and see what happens.

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,  
[MSC v.1916 32 bit (Intel)] on win32  
Type "help", "copyright", "credits" or  
information.  
>>> '5 + 5'  
'5 + 5'  
>>> 5 + 5  
10  
>>>
```

Hmm, this is interesting.  
Please, could you explain?

So, if you remove the quotation marks from the string, Python sees the expression as one thing and not two separate things. It is an operator and responds with the result.

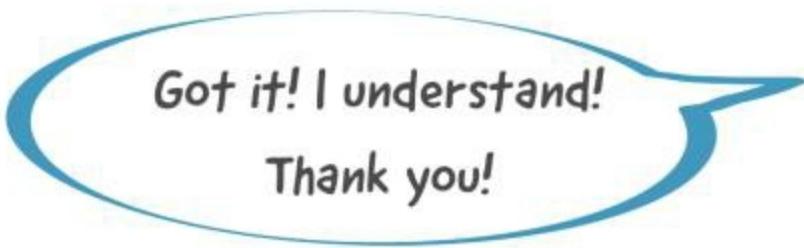
It is very important that you understand how Python handles operators for integers, floating-point numbers, and strings.





## Chapter 07

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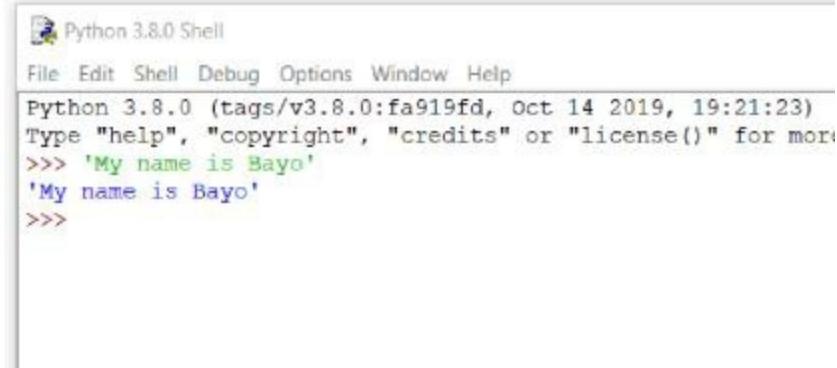


Got it! I understand!  
Thank you!

We do not use strings to do numerical calculations back and forth.

Now, let's enter a string of text characters. Next  
'My name is Bayo' and press **enter**.

What does Python do? It responds with 'My name'



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:21:23)
Type "help", "copyright", "credits" or "license()" for more information
>>> 'My name is Bayo'
'My name is Bayo'
>>>
```

## What is a String Concatenation?

Let's try something a little more complicated. Next, type '**'My name is Bayo.'** + '**'I am a Nigerian.'**' and press **Enter**. What happens? Python joins the two sentences together to form one sentence: **'My name is Bayo. I am a Nigerian.'**

This is known as **string concatenation**, where two strings are joined together using the **+** operator.

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1
tel) [on win32]
Type "help", "copyright", "credits" or "license()"
>>> 'My name is Bayo.' + 'I am a Nigerian'
'My name is Bayo.I am a Nigerian'
>>>
```



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## Chapter 07

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### What Is String Replication?

Let's try something else using strings. Next to the 'Abuja' \* 3 and press **enter**.

What happens? Python repeats the string Abuja to  
'AbujaAbujaAbuja'

This is known as **string replication**, where a string is repeated by using the \* operator.

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019,
(Intel)) on win32
Type "help", "copyright", "credits" or "license"
>>> 'Abuja' * 3
'AbujaAbujaAbuja'
```

```
>>>
```

## Storing Strings in Variables

It is possible to store strings in variables so that we can reuse them when we are developing.

In IDLE, next to the prompt, type in:

```
name = 'What is your name?'
```

Press **enter**, and next to the prompt type in:

**name** and **press enter**.

What happens? Python responds with:

**'What is your name?'**

This is because Python remembers that 'What is your name?' is now called **name**.

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492  
[MSC v.1916 32 bit (Intel)] on win32  
Type "help", "copyright", "credits"  
information.  
>>> name = 'What is your name?'  
>>> name  
'What is your name?'
```

>>>

---

---

## Chapter 07

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Now, in IDLE, next to the prompt type in:

```
mycountry = 'Nigeria'
```

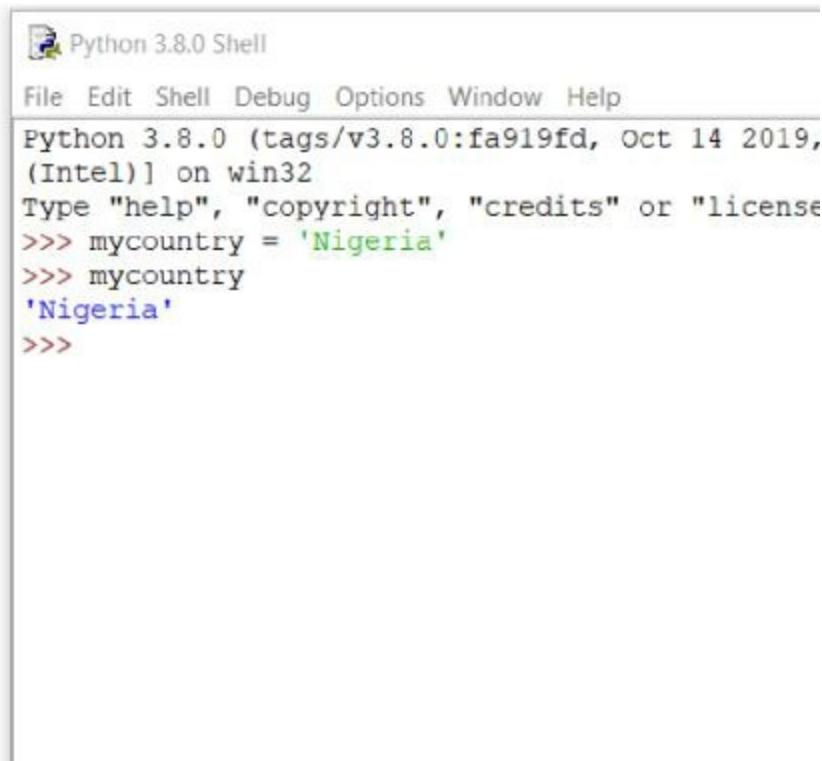
Press enter and then next to the prompt type in:

**mycountry** and press **enter**.

What happens? Python responds with:

'Nigeria'

This is because Python has stored 'Nigeria' in the **mycountry** variable.

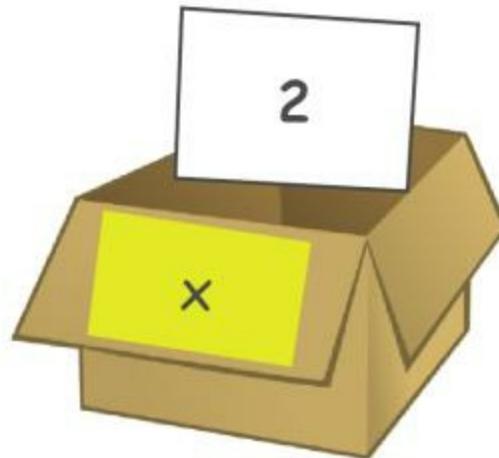


The screenshot shows a window titled "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the Python interpreter's response to the following commands:

```
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, (Intel)) on win32
Type "help", "copyright", "credits" or "license"
>>> mycountry = 'Nigeria'
>>> mycountry
'Nigeria'
>>>
```

## What is a List?

So far, we have understood variables to be a container for one thing such as one number or one string. But sometimes programs need to store many things. For example, we might need to develop a program that stores names of people. Or we might need to store a list of numbers in one variable, rather than in many variables.



Variable containing a single number (integer)

\  
list

A list is a data structure. It is a way of storing a collection of items. Lists can be changed. Once you have created a list, it is possible to add new items to the list, remove items from the list, or change the value of an item in the list.

Lists are very useful when you need to store data.

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## Chapter 07

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To create a list in Python, open IDLE, and next type:

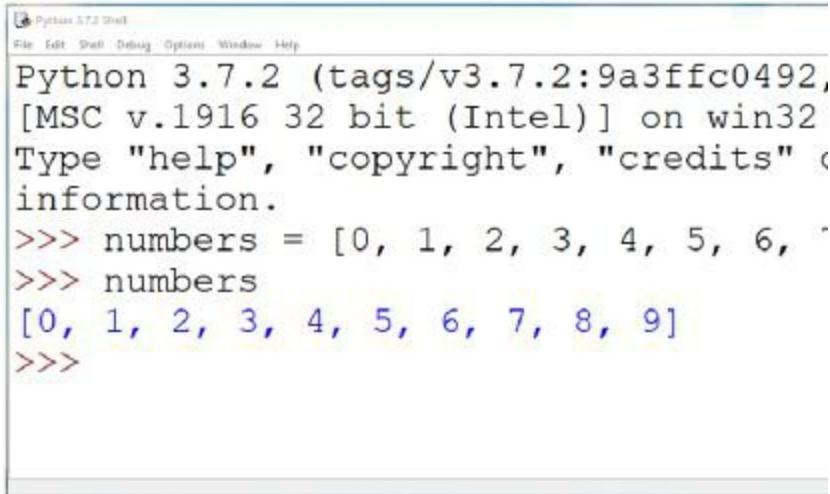
```
numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

Press **enter** (this will save the list). Then type:

```
numbers
```

Press **enter**. How does Python respond? It gives:

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```



The screenshot shows the Python 3.7.2 Shell interface. The title bar reads "Python 3.7.2 Shell". The menu bar includes "File", "Edit", "Shell", "Debug", "Options", "Window", and "Help". The main window displays the following text:

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> numbers
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>>
```

Note that in Python, a list uses square brackets ([ ]). There is no comma in the square brackets.

Note how Python's response is not a string, as there is no comma in the square brackets. Python's response is a number, as numbers would be.

## How to Find Out the Length of a List

Lists always have a length.



I wonder  
the list is  
[0, 1,

If you look at the list carefully, you will see  
between the square brackets. This means there

But you don't need to count the numbers.  
You could just ask Python to tell you!



## Chapter 07

---

To find out the length of the list, type the following  
`len (numbers)` and press `enter`.

How do you think Python will respond? Python responds as follows:

10

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
information.
>>> numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> numbers
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> len(numbers)
10
>>>
```

It is important to remember that the length of the list is not the same as the number of items in the list, but how many numbers there are inside the list.

## How to Access Items in a List



Did you know?  
Accessing a list is similar to accessing a string.



Imagine that you are developing a game where the need to gather food that they find on the island ar

In IDLE, type in the following, which is a list of c  
find and store in their backpack. The items are ar  
found them.

```
backpack = ['water', 'bananas', 'fish', 'noodle
```

Press **enter** to save the list.

Now if you want to find out what the first item in the

```
backpack [0]
```

Then press **enter**, and Python will respond with:

```
'water'
```

This means that the water is the first item in the

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1
tel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> backpack = ['water', 'bananas', 'fish', 'nood
>>> backpack[0]
'water'
>>>
```

A screenshot of the Python 3.8.0 Shell window. The title bar says "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area shows the Python interpreter's prompt (>>>) followed by the creation of a list named "backpack" containing four items: "water", "bananas", "fish", and "nood". Then, the command "backpack[0]" is entered, resulting in the output "'water'". The background of the shell window is light gray, and the text is black.



---

## Chapter 07

I am confused! If we want to know what item in the list is, why didn't we type in `backpack [1]` instead of `backpack [0]`? Surely `backpack [0]` should refer to no item in the list?

That's an excellent question! Python counts a little differently to humans. While humans start counting with the number 1, Python starts counting with the number 0. So, when Python counts it goes 0, 1, 2, 3, 4, ... Python uses this way of counting because it makes it easier to keep track of where each item in a list is. This is known as the zero-based index system.





Oh, I understand now. So, item 0 is the first item in the list, item 1 is the second in the list, and item 2 is the third. I'm so used to counting like a human that it's going to take me a while to get used to counting like a computer.

We know that 'water' is the first item in the list, and 'bread' is the third. Let's now ask Python what the second, third and fourth items are.

Next to the prompt in IDLE type in:

**backpack [1]** and press **enter** to find out what the second item is.  
Python responds with:

'bananas'

Now type in:

**backpack [2]** and press **enter** to find out what the third item is.

Python responds with:

**'fish'**

---

## Chapter 07

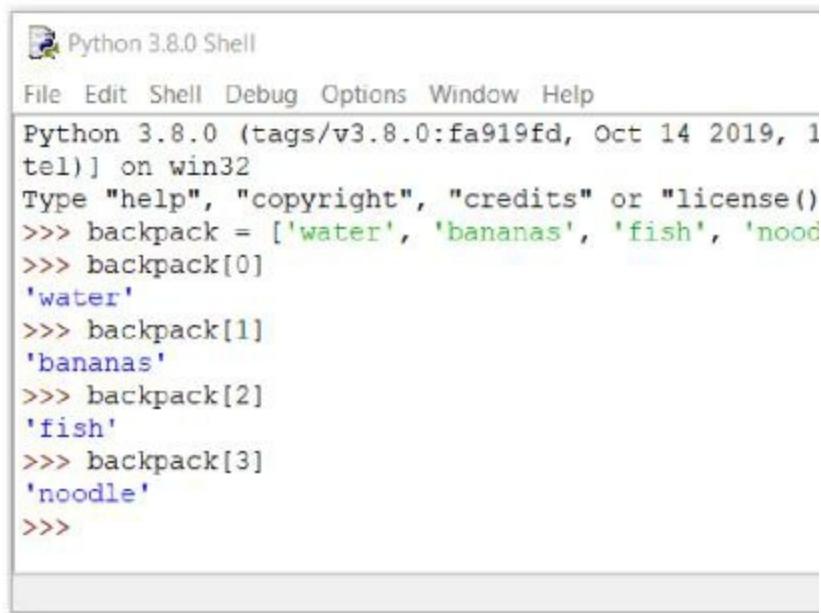
---

Finally, to find out what the fourth item in the list  
**backpack [3]**

Python responds with:

'noodle'

So, Python has told us that the 'bananas' is second  
'noodle' is fourth in the list.



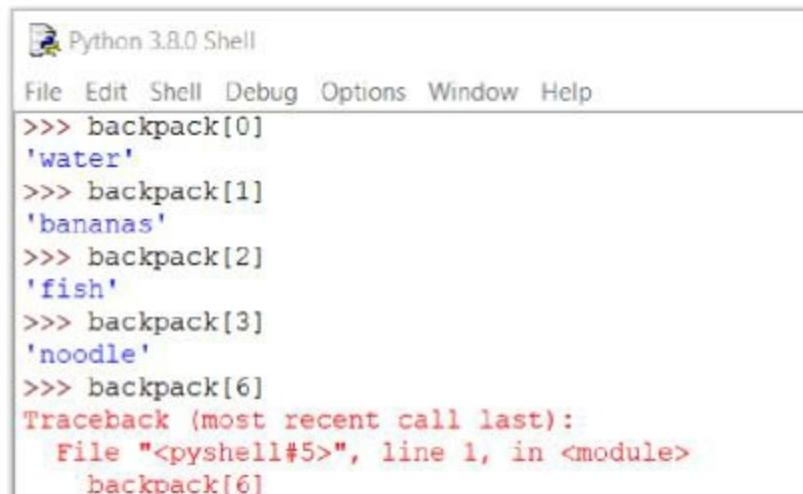
The screenshot shows a window titled "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the Python interpreter's response to a list assignment and indexing. It shows the version information "Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1 tel) on win32", followed by the creation of a list "backpack = ['water', 'bananas', 'fish', 'noodl']" and the output of its elements at indices 0 through 3: "water", "bananas", "fish", and "noodle". The command prompt "">>>>" is visible at the end.

```
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1 tel) on win32
Type "help", "copyright", "credits" or "license()"
>>> backpack = ['water', 'bananas', 'fish', 'noodl']
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>>
```

What do you think would happen if you as

what the seventh item is in the backpack  
Go on...give it a try and see what happens

In IDLE, next to the prompt, type in:  
**backpack [6]** and press **enter**.  
What happens? Python responds with an error message.  
**Traceback (most recent call last):**  
**File "<pyshell#5>, line 1 in <module>"**  
**backpack [6]**  
**IndexError: list index out of range**  
Python is telling us that the index is out of range because

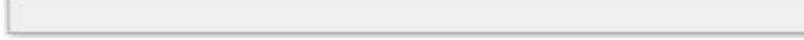


The screenshot shows a Python 3.8.0 Shell window. The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The command line shows the following interaction:

```
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>> backpack[6]
Traceback (most recent call last):
  File "<pyshell#5>", line 1, in <module>
    backpack[6]
```

```
| IndexError: list index out of range
```

```
|>>>
```



## Chapter 07

---

### How to Change Items in a List

Lists are very useful, because you can easily change items in the list.

If you want to change something, you don't need to re-type the entire list.

Let's say that we want to change one of the items bananas, which is second in the list, or item 1 (according to zero-based indexing), to replace bananas with mangoes. Instead of creating

`Backpack[1] = 'mangoes'` and press `enter` to

To check whether Python has made the change to

`print (backpack)`

How does Python respond? Has Python made the c





Wow! Py  
'mango  
is

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:21:23) [MSC v.1919 64 bit (AMD64)]
Type "help", "copyright", "credits" or "license()" for more information.
>>> backpack = ['water', 'bananas', 'fish', 'noodle']
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>> backpack[6]
Traceback (most recent call last):
  File "<pyshell#5>", line 1, in <module>
    backpack[6]
IndexError: list index out of range
>>> backpack[1] = 'mangoes'
>>> print(backpack)
['water', 'mangoes', 'fish', 'noodle']
>>>
```



## Chapter 07

---

### Activity: Strings and Operators

1. If you type `23 + 4` into IDLE and press `enter`, Python will:
  - A. '23 + 4'
  - B. 27
  - C. SyntaxError: invalid syntax
  - D. None of the above.
  
2. If you type `'23 + 4'` into IDLE and press `enter`, Python will:
  - A. '23 + 4'
  - B. 27
  - C. SyntaxError: invalid syntax
  - D. None of the above.
  
3. If you type `'Hello' * 5` into IDLE and press `enter`, Python will:
  - A. 'HelloHelloHelloHelloHello'
  - B. 'Hello' 'Hello' 'Hello' 'Hello' 'Hello'
  - C. 'HHHHHHeeeeeellllllooooo'
  - D. SyntaxError: invalid syntax.

4. `myfriends = ['Toyin', 'Bolu', 'Folu', 'Bayo']` is
- A. a string
  - B. a string replication
  - C. a string concatenation
  - D. a list.

(\*Note: The answers to this activity can be found at the end of the chapter.)

### Solutions for Activity: Strings and Lists

Earlier in this chapter, you completed four multiple choice questions to test your understanding of strings and lists. Here are the answers:

1. If you type `23 + 4` into IDLE and press `enter`, Python will return:
  - A. 27.
  - B. '23 + 4'.
2. If you type '`23 + 4`' into IDLE and press `enter`, Python will return:
  - A. '23 + 4'.
3. If you type '`Hello` \* 5' into IDLE and press `enter`, Python will return:
  - A. 'HelloHelloHelloHelloHello'.
4. `myfriends = ['Toyin', 'Bolu', 'Folu', 'Bayo']` is
  - D. a list.



## Chapter 07

### What is a tuple?

A tuple is like a list. It is a data structure where, unlike a list, a tuple is immutable.



Don't worry! 'Immutable' means 'cannot be changed'. This means you cannot change the values in a tuple.





We can change the data  
cannot change the data

A tuple is a way of storing a collection of data in Python.

- They are like lists, but with a key difference: the values in the tuple cannot be changed.
- When creating a tuple, as a programmer you cannot change it.
- Tuples are useful, for example, when listing things that do not change.



Let's  
to c

To create a tuple list, open IDLE, and next to the command line:

```
months = ('January', 'February', 'March', 'April')
```

Press **enter** (this will save the tuple). Then type:

```
months
```

Press **enter**. How does Python respond? It gives us:

('January', 'February', 'March', 'April')

---

## Chapter 07

---



```
Python 3.7.2 (tags/v3.7.2:9a3ffc04
:52) [MSC v.1916 32 bit (Intel)] o
Type "help", "copyright", "credits"
or information.
>>> months = ('January', 'February'
>>> months
('January', 'February', 'March', '
>>>
```

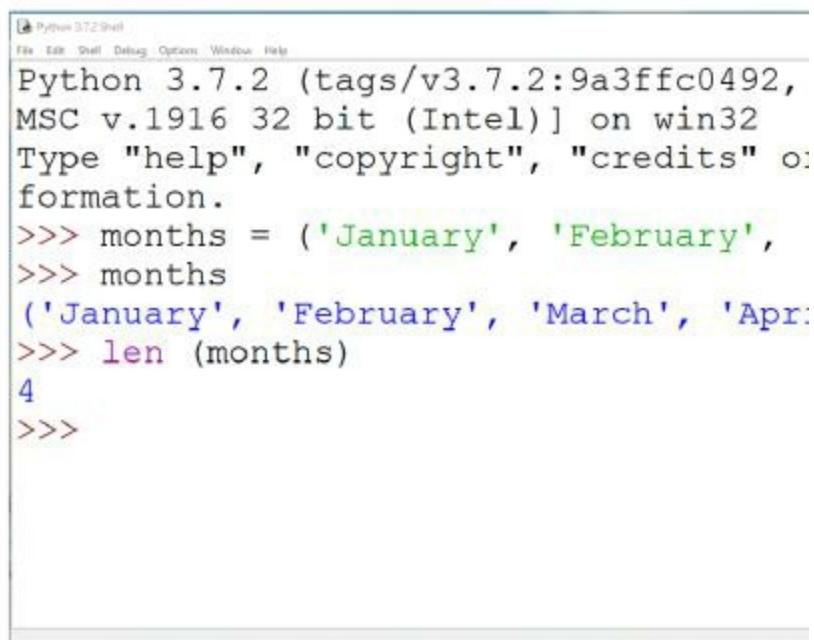
Note that in Python, a tuple uses round brackets ( ) and a list uses square brackets [ ].

Did you know that just like with lists you can find out the length of a tuple and you can access a particular item in a tuple?

## How to Find Out the Length of a Tuple

To find out the length of a tuple, all you need to do that you use to find the length of a list. Type the **len (months)** and press **enter**.

How does Python respond? Python responds with the items contained in the tuple.



```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Mar 25 2019, 14:52:58) [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> months = ('January', 'February',
...           'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December')
>>> months
('January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December')
>>> len (months)
12
>>>
```

## How to Access Items in a Tuple

To access items in a tuple, you use the exact same previous chapter. For example, if you want to find the first item you would type the following into IDLE:

**months [0]**

Then press **enter**, and Python will respond with:

January

**January**

This means that January is the first item in the tu

---

## Chapter 07

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Mar 25 2019, 14:31:15) [MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> months = ('January', 'February',
...             'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December')
>>> len(months)
12
>>> months[0]
'January'
>>>
```

### Try to Change an Item in a Tuple



Ok, you will remember that we can't make changes to a list, we can only make changes to a tuple. Let's check and see what happens when we try to change a ch



Let's try and change the month 'January' in the 'December'. In IDLE type in:

```
months[0] = 'December'
```

You'll remember that we used this method previously: typing in months [0] 'December' we are telling Python to change the first item in the tuple (months) from 'January' to 'December'.

Python responds with an error message, to remind us tuples are immutable:

**TypeError: 'tuple' object does not support item assignment**

```
Python 3.5.3 Shell
File Edit Shell Debug Options Window Help
Python 3.5.3 (v3.5.3:1880cb95a742, [MSC v.1900 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license".
>>> months = ('January', 'February'
>>> months
('January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December')
>>> len(months)
12
>>> months[0]
'January'
>>> months[0] = 'December'
Traceback (most recent call last):
  File "<pyshell#4>", line 1, in <module>
    months[0] = 'December'
```

```
|-----|  
| TypeError: 'tuple' object does not  
| >>>
```

---

## Chapter 07

---

Wow!

Now I understand better!

### What Is a Dictionary?



Oh, I know  
A dictionary is the  
with about 1,000  
dictionary to find  
we do



In Python, a dictionary is quite different to the dictionary that you use to find the meaning of words.

In Python, a dictionary is also known ‘map’. Read on to find out more

In Python, a dictionary is a data structure that is used in the programming world as an **associative array**. Dictionaries share some of the same characteristics as lists:

- they are a collection of elements; and
- they are mutable, which means that they can be changed.

A key difference between dictionaries and lists is that they contain:

We access elements in lists by their position in the list.

*With dictionaries, we access items through keys.*

---

## Chapter 07

Let's create a dic

Let's go back to the example where you in  
of the game where the player is stranded  
you created a list of the foods that t  
on the island and stored

Now, let's use a dictionary to create  
people who have been strai



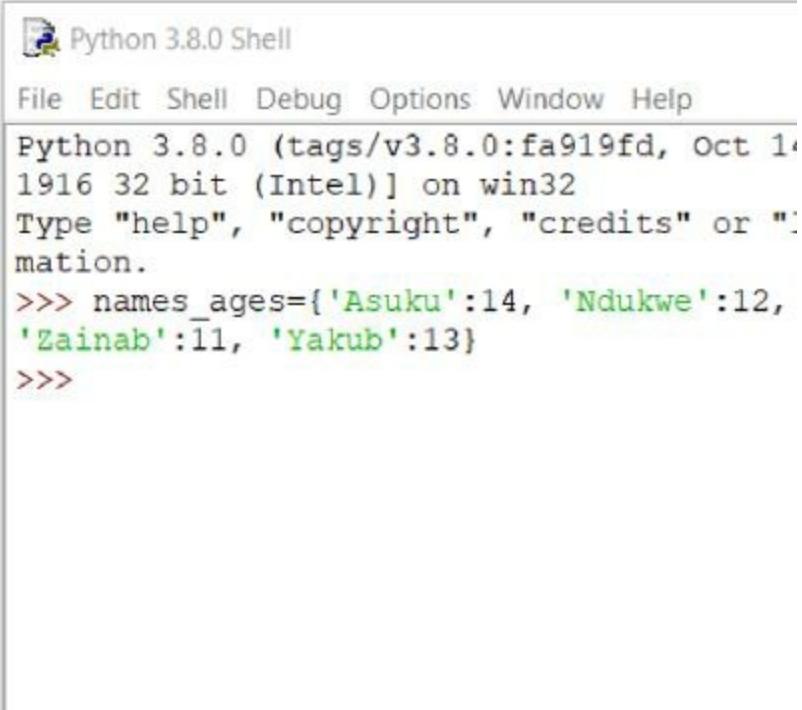
Let's say that the names and ages of the people wh

Name (Key)
Asuku
Ndukwe
Tomi
Seinde
Zainab
Yakub

Open IDLE, and enter the names (keys) and ages (values).

```
names_ages = {'Asuku':14, 'Ndukwe':12, 'Tomi':13,
              'Zainab':11, 'Yakub':13}
```

Press **enter** to save the dictionary.



The screenshot shows the Python 3.8.0 Shell window. The title bar says "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. Below the menu is a copyright notice: "Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 1 2018, 19:16:32) [MSC v.1916 32 bit (Intel)] on win32". It also says "Type "help", "copyright", "credits" or "license" for more information." In the shell area, the code `>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Tomi':13, 'Zainab':11, 'Yakub':13}` is entered, followed by three blank lines indicating the end of the input.



---

## Chapter 07

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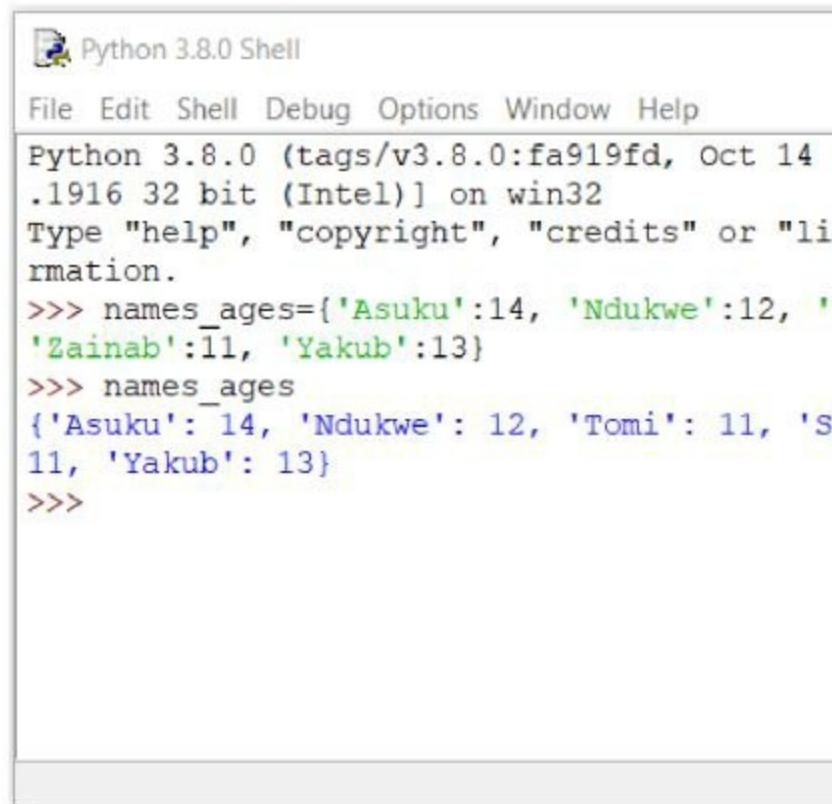
Note that when we create a dictionary, we use **colon** : to separate keys from values. We also use **curly braces** { } to enclose the key-value pairs, called **squiggly brackets**.

To check whether the dictionary has been saved, run the command:

**names\_ages**

Press **enter**. Python responds with:

{'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Seinde':13}



The screenshot shows the Python 3.8.0 Shell interface. The title bar says "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. Below the menu is a welcome message: "Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2018, 1916 32 bit (Intel)) on win32". It also says "Type "help", "copyright", "credits" or "license" for more information." The main window contains the following Python code and its output:

```
>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Zainab':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Seinde': 13}
>>>
```



Cool! Let's  
Let's ask it  
st

To find out how old Seinde is, type in the fol

```
print (names_ages['Seinde'])
```

And Python responds with:

12

To find out how old Zainab is, type in the fol

```
print (names_ages['Zainab'])
```

And Python responds with:

11



## Chapter 07

---



The screenshot shows a window titled "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the following Python session:

```
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct .1916 32 bit (Intel)) on win32
Type "help", "copyright", "credits" or
rmination.

>>> names_ages={'Asuku':14, 'Ndukwe':12,
'Zainab':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11,
11, 'Yakub': 13}
>>> print (names_ages['Seinde'])
12
>>> print (names_ages['Zainab'])
11
>>>
```

Wow!

Python is so clever!

When creating the dictionary, each name (key) must

keys are always single elements, values can be more lists within lists, functions, etc.

Always use curly braces { } when creating a dict

## How to Add to a Dictionary

We are able to add elements to a dictionary. Let's add children who have been stranded on the island. Add to the dictionary, in IDLE, type in:

```
names_ages['Azuka']=9
```

Press **enter**. To check if Python has added Azuka : S

```
names_ages
```

Press **enter**, and Python responds with:

```
{'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Seinde':12, 'Zainab':11, 'Yakub':13}
```

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
rmation.
>>> names_ages={'Asuku':14, 'Ndukwe':12,
'Zainab':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11,
11, 'Yakub': 13}
>>> print (names_ages['Seinde'])
12
>>> print (names_ages['Zainab'])
11
>>> names_ages['Azuka']=9
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11,
11, 'Yakub': 13, 'Azuka': 9}
```

```



---

## Chapter 07

---

### How to Change Elements in a Dictionary

A dictionary, like a list, is mutable and so we are able to change what it already contains.

Let's say that Ndukwe has just turned 13. To change his age, type in:

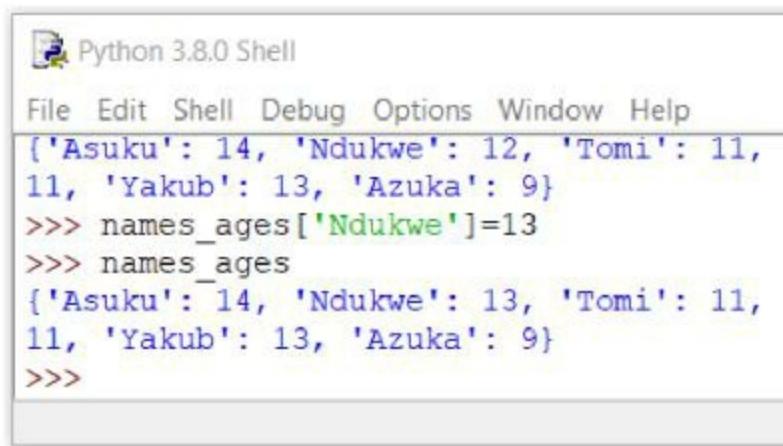
```
names_ages['Ndukwe']=13
```

Press **enter**. Then, to check if Python has changed Ndukwe's age, type in:

```
names_ages
```

Press **enter**. Python responds with:

```
{'Asuku':14, 'Ndukwe':13, 'Tomi':11, 'Seinde':12, 'Zo...
```



The screenshot shows a window titled "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the following Python session:

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
['Asuku': 14, 'Ndukwe': 12, 'Tomi': 11,
11, 'Yakub': 13, 'Azuka': 9}
>>> names_ages['Ndukwe']=13
>>> names_ages
{'Asuku': 14, 'Ndukwe': 13, 'Tomi': 11,
11, 'Yakub': 13, 'Azuka': 9}
>>>
```

Python has changed Ndukwe's age to 13 in the names\_ages dictionary.

## Deleting Elements from a Dictionary

As a dictionary is mutable, we can remove or delete elements from it.

Let's say we want to delete Asuku from the names\_ages dictionary. To do so, type in the following:

```
del names_ages['Asuku']
```

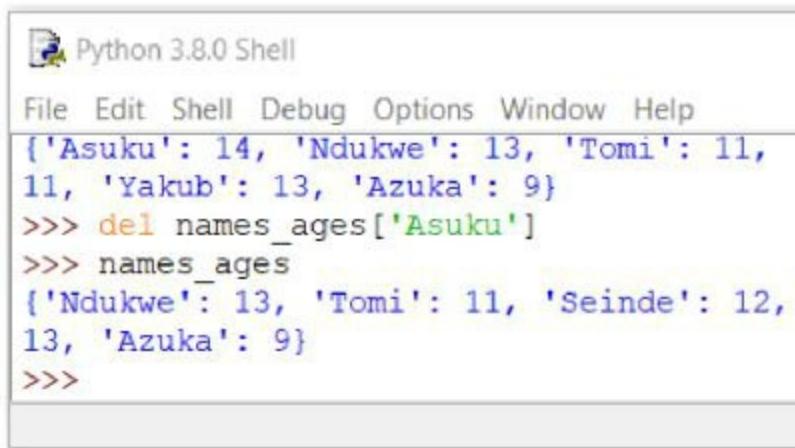
Press **enter**. To check if Asuku has indeed been removed, type **names\_ages** next to the prompt type in:

```
names_ages
```

Press **enter**. Python responds with:

```
{ 'Ndukwe':12, 'Tomi':11, 'Seinde':12, 'Zainab':13 }
```

This shows that Python has removed Asuku, together with its value 14, from the names\_ages dictionary.



The screenshot shows a window titled "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area contains the following Python session:

```
{'Asuku': 14, 'Ndukwe': 13, 'Tomi': 11, 'Yakub': 13, 'Azuka': 9}
>>> del names_ages['Asuku']
>>> names_ages
{'Ndukwe': 13, 'Tomi': 11, 'Seinde': 12, 'Yakub': 13, 'Azuka': 9}
>>>
```



### References:

- The following sources were consulted in the preparation of this chapter.
- Payne, B. 2015. Teach Your Kids to Code. San Francisco: No Starch Press.
  - Sweigart, A. 2015. Automate the Boring Stuff with Python. San Francisco: No Starch Press.
  - Mulongo, C. 2019. 10 Interesting Facts About Python. Technotification. [ONLINE] Available at: <https://technotification.com/2019/01/interesting-facts-python-programming/>
  - Wentworth, P., Elkner, J., Downey, A.B., and Meeks, D. 2018. How to Think Like a Computer Scientist: Learning with Python 3. Foundation.





## Chapter 08

---

In this chapter, we are going to learn about:

- ✓ what a loop is
- ✓ iteration over a list
- ✓ iteration over a dictionary
- ✓ how to use the range function.



In this chapter, we are going to learn about:

A loop is a great help to combine multiple lines of code together to avoid repeating them to avoid repetition.

Let's start!

## What Is a Loop?

Loops are often used in computer programming, no matter what programming language you're using. Loops are a set of instructions that repeat a process a specific number of times until a process is completed, or until a condition is met. Loops help programmers to repeatedly execute a block of code many times over and over again, and they save time as you don't have to write the same code multiple times.

### "For loops" and "while loops"

In this book, we will look at two loops: the **for loop** and the **while loop**.

A **for loop** is used to repeat a sequence. The sequence can be a list of numbers or a string. The **for loop** executes a piece of code, like a **print** statement, a specific number of times.

There is also the **while loop**, which executes until a certain condition is met. A **for loop** is a loop of a specific length, whereas a **while loop** is a loop that continues until you don't know ahead of time when it will need to stop.





## Chapter 08

Sure, Let's have a closer look at the `for` loop. Suppose you want to develop a program that prints a name eight times. What would you enter into Python?

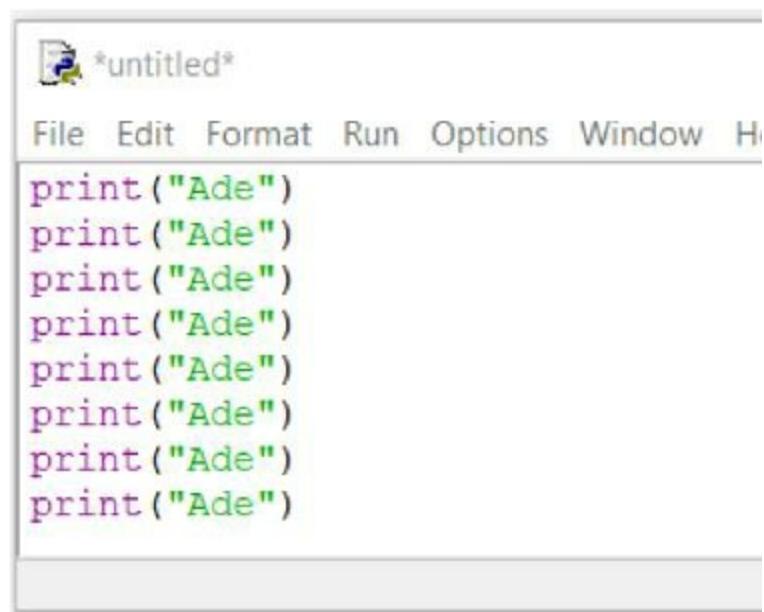


Maybe I can use the function `for` loop.

Open up IDLE, and select **File**, and then select **New File**. Enter the following code:

```
print("Ade")
```

```
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
```



```
*untitled*
File Edit Format Run Options Window Help
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
print("Ade")
```

Now save the program to your desktop by choosing **File**, then **Save As**. You will be prompted for a file name, so enter **Ade\_Eight.py**. Then choose **Run**, and **Run Module**. The program will then output the string **Ade** eight times.



## Chapter 08

---

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2
32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lic
on.
>>>
=====
RESTART: C:/Users/ayoolabi
=====
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
>>>
```



Oh no!  
That was so boring  
eight times to create  
fun at all! Isn't that  
way



Yes, there is! We can create this program much faster using **for** loops.  
Let me show you how.

You can write a very simple programme that loops loops. To do this, open IDLE and type in:

```
for i in range(8):
```

```
    print("Ade")
```

Press **enter** to save the code. Then press **enter** again.

Ade

Ade

Ade

Ade

Ade

Ade

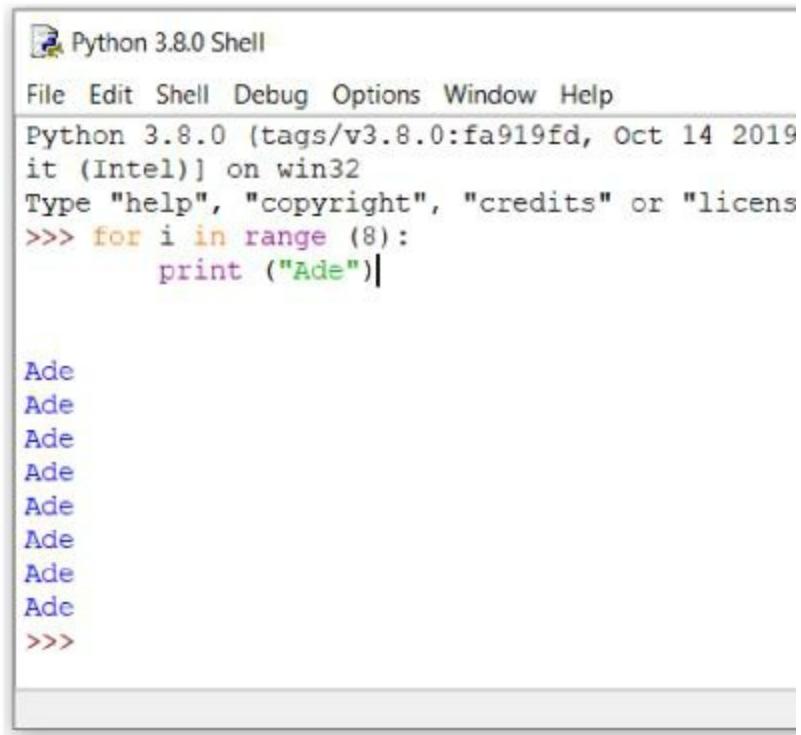
*Ade*

*Ade*

---

## Chapter 08

---



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019
it (Intel) on win32
Type "help", "copyright", "credits" or "licens
>>> for i in range (8):
    print ("Ade")|
```

```
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
>>>
```



*That is so cool! I am going to start writing on my own.*

Let's have a look and learn.

LET'S HAVE A LOOK AND LEARN...

```
for i in range(8):  
    print("Ade")
```

It is extremely impo

Indentations are spa

Note the four spaces

- **for** and **in** are keywords for the **for loop**. The
- The **i** in the code is a count, or number variable. It counts the number of objects, such as a string, list or tuple. Python uses **i** as the loop variable. The **i** stands for the loop turn or what ever you want it to stand for. For example the **i** refers to the code **print("Ade")**.
- The **range(8)** indicates that **print("Ade")** must be repeated 8 times.
- Take note of the colon (**:**) that is at the end of the line. You must not leave out this colon.
- In this example, **print("Ade")** is what must be repeated 8 times. Note that **print("Ade")** is indented, and that the word **for** is not indented.

## Iteration Over a List

'Iteration'? What on earth does that mean?

'iteration' mean?

Why does Python have to use all these big words? It makes my head hurt!



## Chapter 08

---

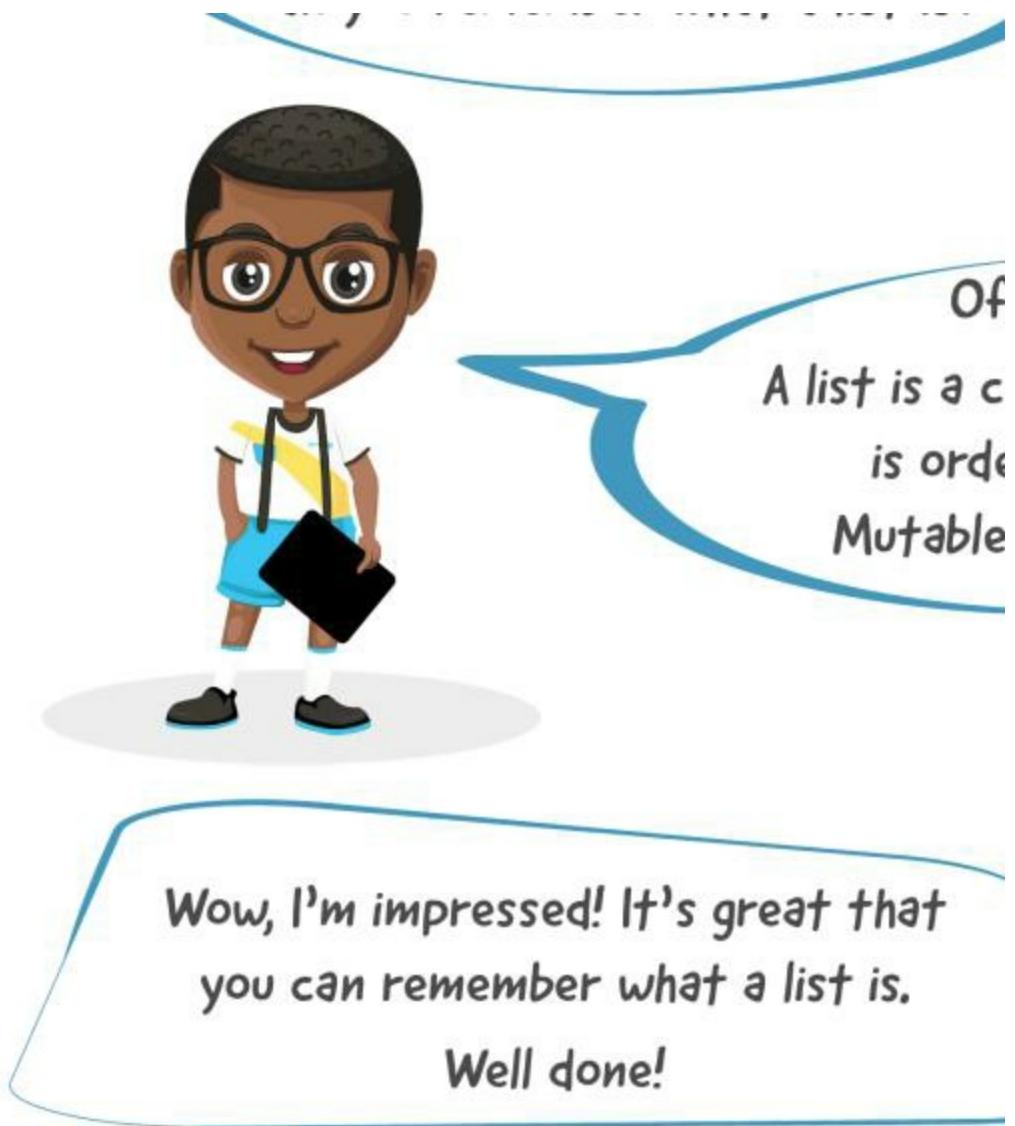
Don't feel stressed! 'Iteration' for a loop. For example, when you the function `print("Ade")`, the iterated, or looped. The result w printed on the screen



Techopedia defines **iteration** as 'a process wherein repeated in a sequence a specified number of time first set of instructions is executed again, it is cal  
<https://www.techopedia.com/definition/3821/iteration>)

Let's now look at how to iterate over a list.

Can you remember what a list is?



We will create a new list, this time of colours: white

**loop** to iterate through, or loop through, this list.

Open IDLE, and type in the list:

```
colour = ['white', 'green', 'blue', 'yellow']
```

Press **enter** to save the list.

Now, to iterate through the list, type in the follow

```
for i in colour:
```

FOR I IN COLOUR.

print(i)

---

## Chapter 08

---

Press **enter** to save the code. Then press **enter** again displaying the items in the list:

**white**

**green**

**blue**

**yellow**



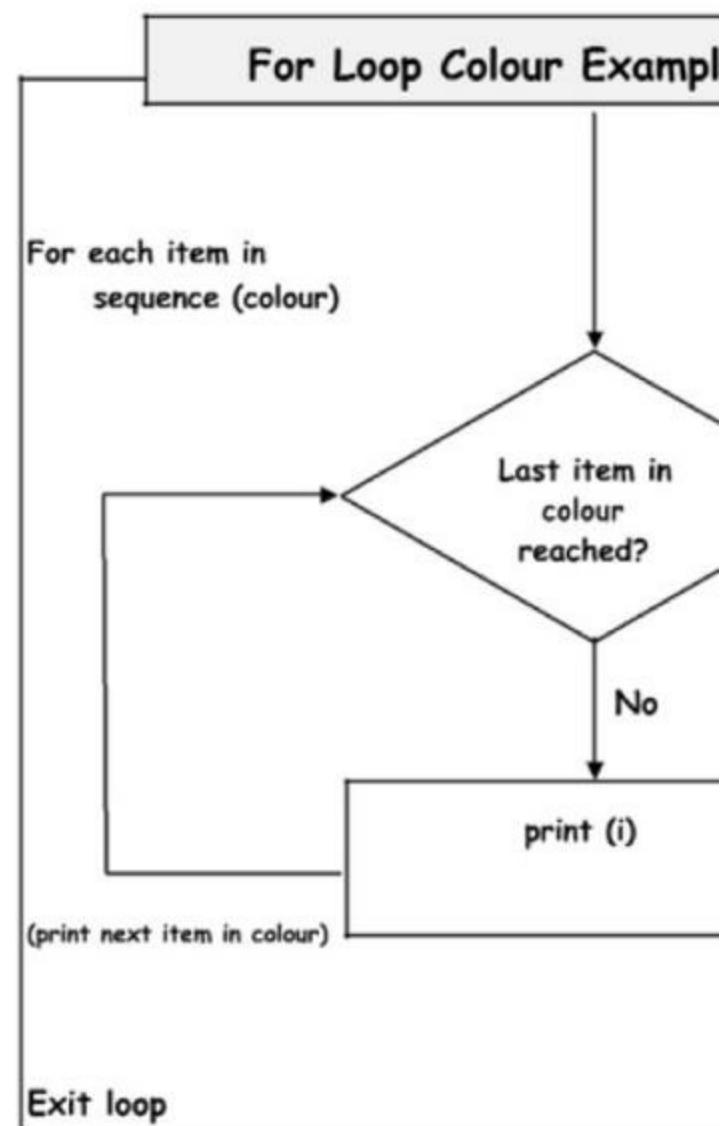
The image shows a screenshot of the Python 3.8.0 Shell window. The title bar reads "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The main area displays the Python version and build information, followed by a code snippet and its output. The code defines a list 'colour' containing four items: 'white', 'green', 'blue', and 'yellow'. A for loop iterates over the list, printing each item. The output shows the words 'white', 'green', 'blue', and 'yellow' printed sequentially.

```
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
formation.
>>> colour = ['white', 'green', 'blue',
>>> for i in colour:
        print(i)

white
green
blue
yellow
>>> |
```

So the code that you have developed tells the computer to use the variable **i** and then to print the contents of the list.

THE FOR LOOP IS USED MOSTLY TO PRINT THE CONTENTS OF A LIST





## Chapter 08

---

### Iteration Over A Dictionary



Now that we know  
a list, let's try to it.  
Can you remember  
P

I do remember! A dictionary  
is an unordered collection of  
key-value pairs.

There are a number of ways to iterate over a dictionary:

- you can iterate through all the keys; and
- you can iterate through all the values.

## Iteration Through Keys

First, let's look at how to iterate through all the keys in a dictionary based on different types of animals in a "zoo" dictionary by typing in:

```
zoo = {'Lion':25, 'Tiger':9, 'Elephant':3, 'Monkey':1}
```

Press **enter** to save the dictionary.

Now let's iterate through all the keys. To do this, type:

```
for i in zoo:
```

```
    print(i)
```

Press **enter** to save the code. Then press **enter** again to run the code and printing the keys from the dictionary:

Lion

Tiger

Elephant

Monkey

Birds



## Chapter 08

---



The image shows a screenshot of the Python 3.8.0 Shell. The title bar says "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. A message in the top left says "Type "help", "copyright", "credits" or "mation.". Below that, a user has typed:

```
>>> zoo = {'Lion':25, 'Tiger':9, 'Elephant':69}
>>> for i in zoo:
    print(i)
```

The output window shows the results of the loop:

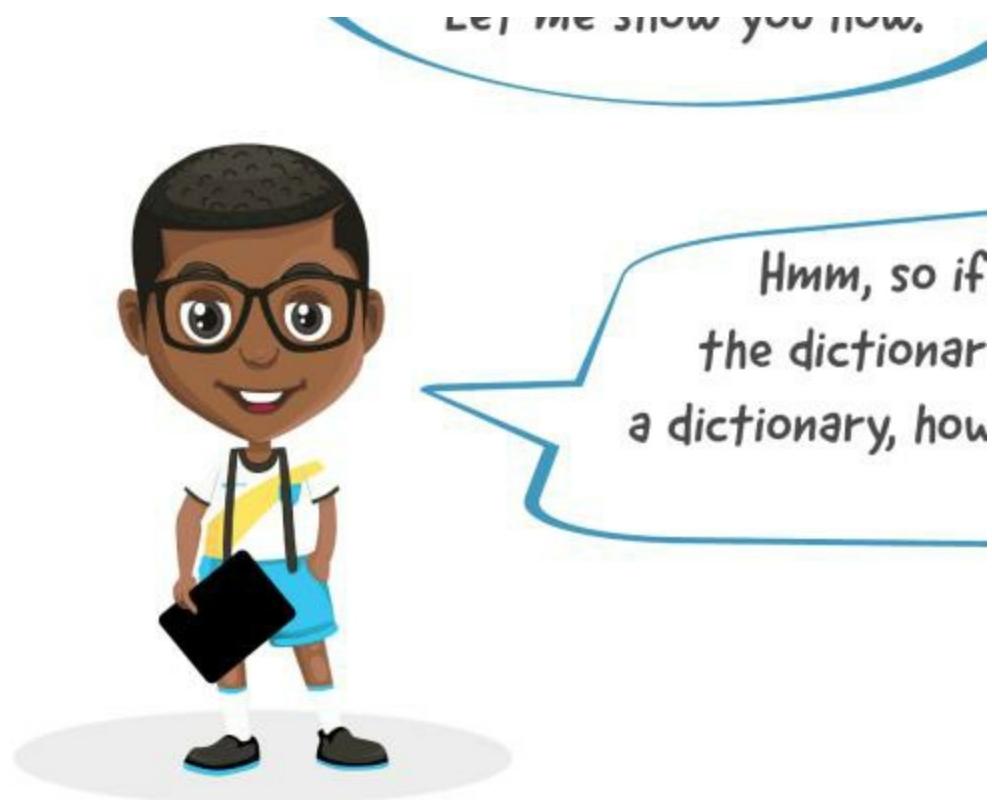
```
Lion
Tiger
Elephant
Monkey
Birds
>>>
```

What you can see in the example above is that when the loop variable (i) is assigned to the dictionary it iterates through the keys (the names of the animals in the zoo).

## Iteration Through Values

That's a good question!

Let me show you how.



You can access the dictionary's values with the **for**

In IDLE, type in:

```
for i in zoo.values():
```

```
    print(i)
```

Press **enter** to save the code. Then press **enter** again to print the values in the dictionary:

25

9

3

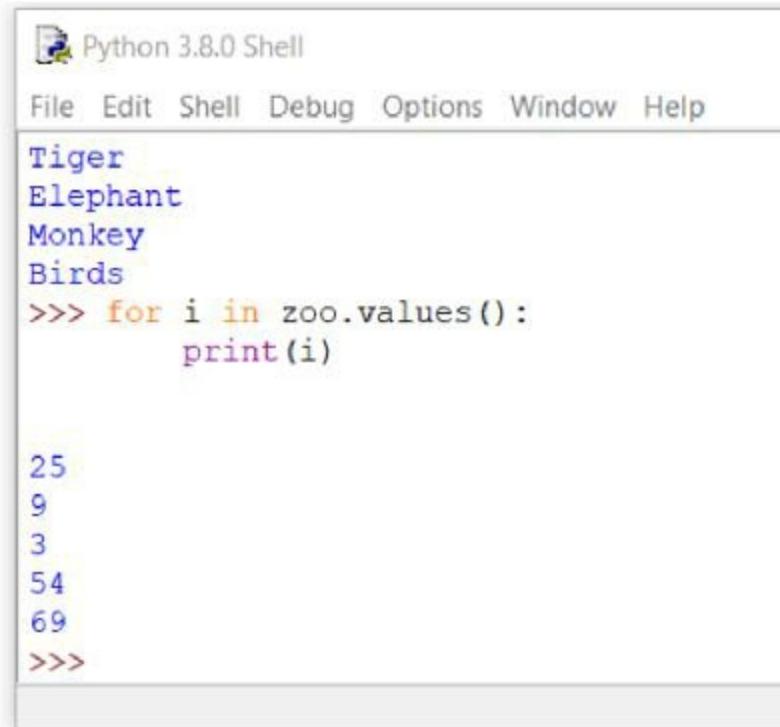
EA

०४

69

---

## Chapter 08



The image shows a screenshot of the Python 3.8.0 Shell. The window title is "Python 3.8.0 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, and Help. The code input area contains the following:

```
Tiger
Elephant
Monkey
Birds
>>> for i in zoo.values():
    print(i)

25
9
3
54
69
>>>
```



Wow! P  
Okay, so now I  
the keys in a dic  
also know how to  
a dictiona



## Using the Range Function

Let's say we wanted to iterate the values 1 to 15.  
type the following into IDLE:

```
for x in (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,  
          print(x)
```

Press **enter** to save the code. Print **enter** again to  
Python responds with:

```
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14
```

14

15

---

## Chapter 08

---

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2  
32 bit (Intel)] on win32  
Type "help", "copyright", "credits" or "lic  
>>> for x in (1,2,3,4,5,6,7,8,9,10,11,12,13  
    print(x)  
  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15
```

No way! That involves far too much code.  
I thought you said that using for loops was a good way of reducing the amount of code you have to type?



Yes! **For loops** do reduce the amount of code we have to write. The computer can repeat the instruction to iterate the loop many times in a much easier way by using the **for loop** with **range**.

Let me show you how.



We can use the **range** function with **for loops** to make our lives easier. Open IDLE, and type in:

```
for x in range(1,16):
```

`print(x)`

---

## **Chapter 08**

---

Press **enter** to save the code. Then press **enter** with:

1

2

3

4

5

6

7

8

9

10

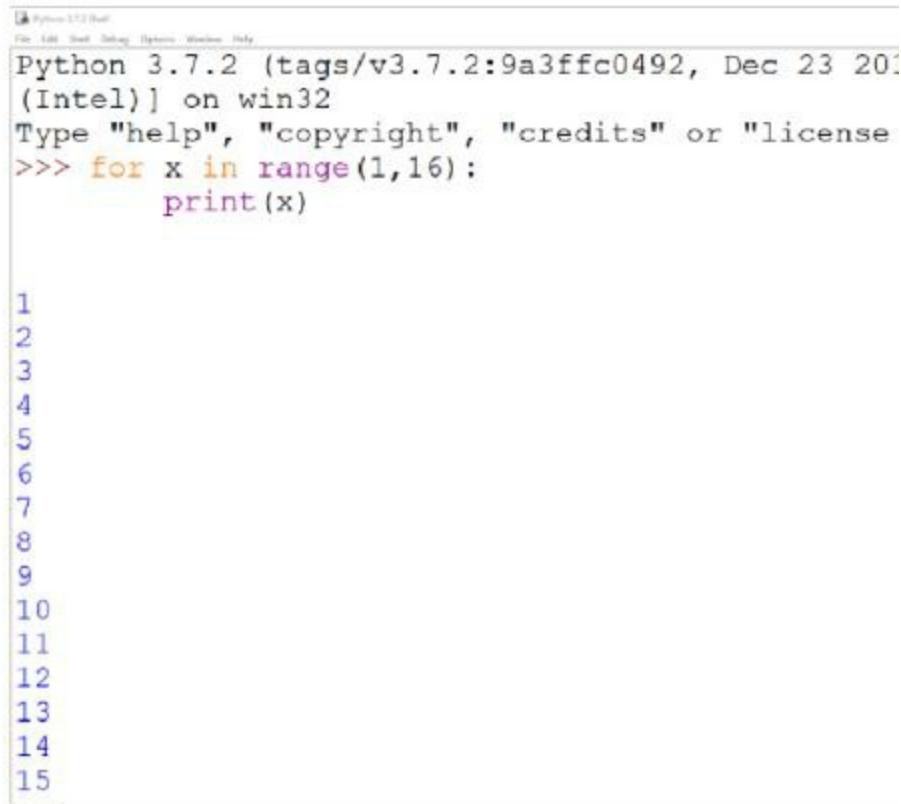
11

12

13

14

15



The screenshot shows a Python 3.7.2 IDLE window. The menu bar includes File, Edit, Start, Debug, Help, Window, Help. The code area displays:

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2019, (Intel)) on win32
Type "help", "copyright", "credits" or "license"
>>> for x in range(1,16):
    print(x)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Cool! So, using the `range` function with the `for loop` numeric values!

Here's another example showing how we can use the `range` function. If we want to generate the numbers from 3 to 21, in increments of 3, we type the following into IDLE:

`for x in range (3,22,3):`

`print(x)`

Press **enter** to save the code. Then press **enter** to

---

## Chapter 08

---

Python responds with:

3

6

9

12

15

18

21

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2
6 32 bit (Intel)) on win32
Type "help", "copyright", "credits" or "lic
.
>>> for x in range(3,22,3):
    print(x)

3
6
9
12
15
18
21
>>>
>>>
```

In this example, three numbers are contained in the range(3, 22, 3):

- the first number (3) in the brackets refers to the starting point of the iteration
- the second number (22) in the brackets refers to the last number that the iteration must end on
- the third number (3) in the brackets refers to the step size for each iteration. In other words, how much each iteration moves forward.



In IDLE, type in:

```
for x in range (5,0,-1):  
    print (x, 'little monkeys jumping on the')
```

mama called the doctor and the doctor  
bed'!)

---

## Chapter 08

---

Press **enter** to save the code. And then press **enter** with the song, which counts down from 5 monkeys on the bed:

```
Python 3.7.2 (default, Mar 12 2019, 14:32:52)
[PyQt5 5.12.3]|_>>> for x in range(5,0,-1):
    print(x, 'little monkeys jumping
bumped his head, mama called the doctor a
monkeys jumping on the bed!')

5 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
4 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
3 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
2 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
1 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
```

Multiple Choice A

- I. Which of the following statements is false?
- A. Loops save time when developing computer programs
  - B. Loops reduce the amount of repetitive code
  - C. Loops increase the amount of repetitive code
  - D. One type of loop is the for loop.
2. Which of the following lines of code will print "Peter"?
- A. `for i in range(x):  
 print("Peter")`
  - B. `for i in range(1-1):  
 print("Peter")`
  - C. `for i in range(11)  
 print("Peter")`
3. Which of the following is the correct code to print the dictionary?
- A. `for i in grocery_list:  
 print(i)`
  - B. `for i in grocery_list.values():  
 print(i)`
  - C. `for grocery, price in grocery_list.items():  
 print(grocery, price)`
  - D. None of the above

(\*Note: The answers to this activity can be found at the end.)

**L**et's begin! The answers to this activity can be found at the end.

---

## **Chapter 08**

---

### **Practical Activities**

#### **1. Going Loopy With Your Age**

- If your age is currently an even number, count by 2 numbers until it reaches your age.
- If your age is currently an odd number, count by 3 numbers until it reaches your age.

#### **2. Let's Go Shopping!**

Your mom has asked you to go shopping. She has given you a list of the names of the items that you must buy, as well as the amount of each item that you must purchase.

| Grocery Item |  |
|--------------|--|
| Apples       |  |
| Eggs         |  |
| Bread        |  |
| Potatoes     |  |
| Tomatoes     |  |

- 2.1 Create a dictionary for your mom's grocery store.
- 2.2 Once you have created the dictionary, use
  - iterate through the keys.
  - iterate through the values.

(\*Note: The answers to this activity can be found at the end of the chapter.)

---

### Solutions for Multiple Choice Questions

Earlier in this chapter, you completed three multiple choice questions to test your understanding of loops and iterations.

Here are the answers to that activity:

- 1. Which of the following statements is false?**  
C. Loops increase the amount of repetitive code.
- 2. Which of the following lines of code will print "Peter"?**  
D. `for i in range(11):`  
  
 `print("Peter")`
- 3. Which of the following is code to iterate through the grocery list?**  
B. `for i in grocery_list.values():`  
  
 `print(i)`

L -----

---

## Chapter 08

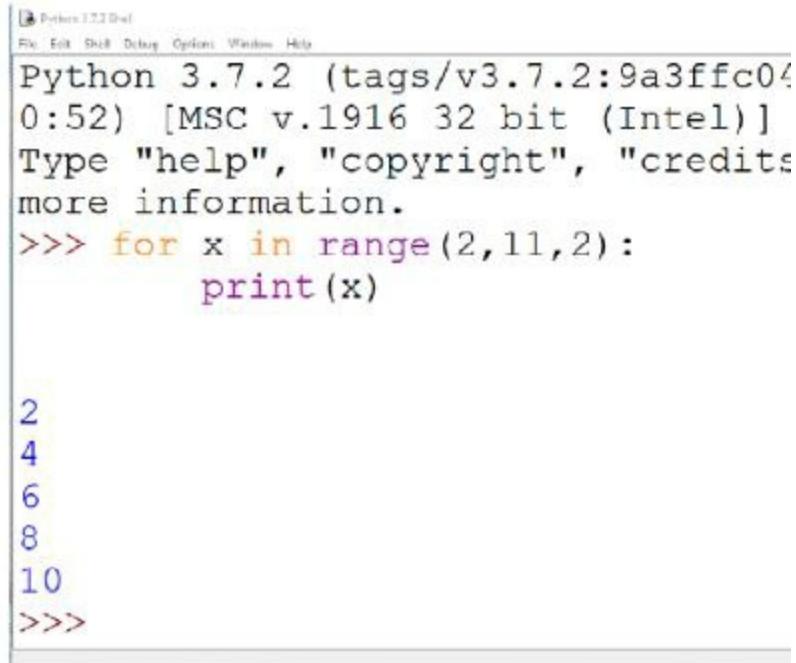
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### Solutions for Practical Activities

#### 1. Going Loopy with Your Age

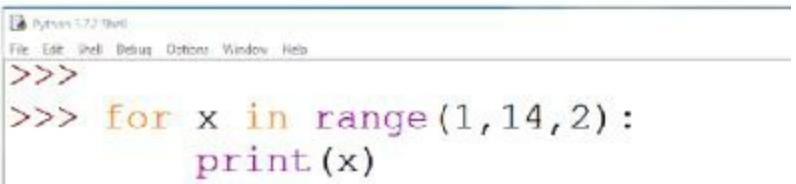
Two sample answers for this activity are provided

- The one sample answer is for a person who (an even number).
- The other sample answer is for a person w (an odd number)



```
Python 3.7.2 (tags/v3.7.2:9a3ffc04, Oct 12 2018, 10:43:48) [MSC v.1916 32 bit (Intel)]
Type "help", "copyright", "credits" or "license" for more information.
>>> for x in range(2,11,2):
        print(x)

2
4
6
8
10
>>>
```



```
Python 3.7.2 (tags/v3.7.2:9a3ffc04, Oct 12 2018, 10:43:48) [MSC v.1916 32 bit (Intel)]
Type "help", "copyright", "credits" or "license" for more information.
>>>
>>> for x in range(1,14,2):
        print(x)
```

```
1  
3  
5  
7  
9  
11  
13  
>>>
```

## 2. Let's Go Shopping

The model answer to this activity is provided below

```
Python 3.7.2 Shell  
File Edit Shell Debug Options Window Help  
Python 3.7.2 (tags/v3.7.2:9a3ffc0,  
20:52) [MSC v.1916 32 bit (Intel)]  
Type "help", "copyright", "credits"  
more information.  
>>> grocery_quantity={'Apples':12,  
, 'Potatoes':12, 'Tomatoes':4}  
>>>  
>>> for i in grocery_quantity:  
    print(i)  
  
Apples  
Eggs  
Bread  
Potatoes  
Tomatoes  
>>>  
>>> for i in grocery_quantity.val  
    print(i)
```

|    |
|----|
| 6  |
| 2  |
| 12 |
| 4  |

---

---

## Chapter 08

---

```
>>> for grocery, quantity in grocery_list:  
    print(grocery, quantity)
```

```
Apples 12  
Eggs 6  
Bread 2  
Potatoes 12  
Tomatoes 4  
>>>
```

Well done!

You've learnt so much about Python Programming. I hope you enjoyed this chapter as much as I did!

- |-----|
- | **References:**
- |-----|
- | The following sources were consulted in the preparation of this book.

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- Wentworth, P., Elkner, J., Downey, A.B. and Meeks, C. 2018. How to Think Like a Computer Scientist: Learning with Python 3. 5th ed. Boston, MA: MIT Press.





---

# Building

# 1million African AI talent in 10 years:

---

The Data Science Nigeria  
Foundation end-to-end  
Artificial Intelligence  
ecosystem







OUR  
VISION

OUR  
PLATFORMS

OUR  
ACHIEVEMENTS

LE

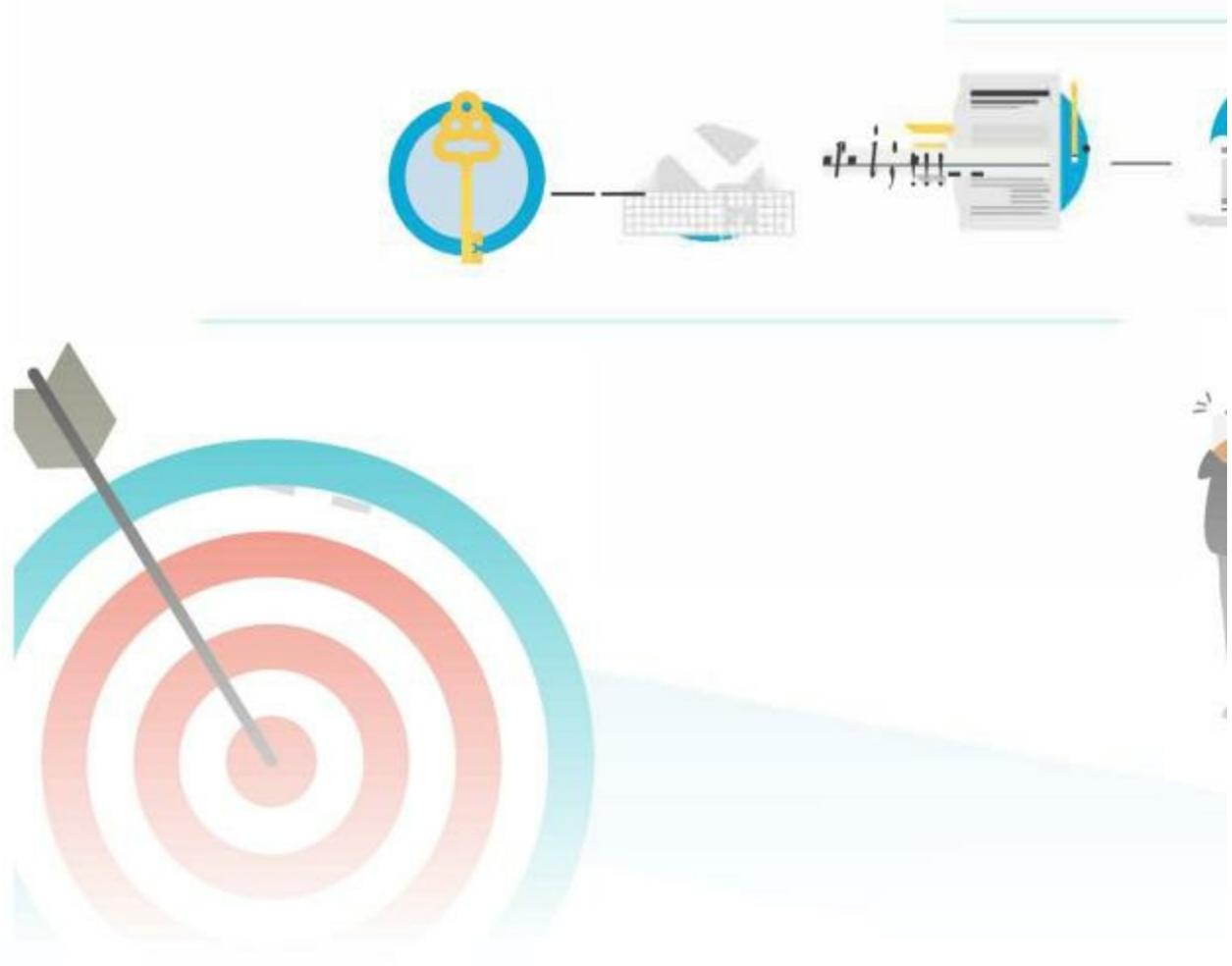
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## OUR VISION

---

To build a world-class Artificial Intelligence research and innovation ecosystem that impact transformational research, business applications, AI-first start-ups, support social good use cases. We are committed to training one million AI talents in 10 years and thus position Nigeria as one of the top 10 AI talent/knowledge destinations in the world, creating significant GDP multiplier impact.

We are poised to accelerate Nigeria's socio-economic development through a solution-oriented approach that integrates machine learning in solving social/business challenges. This will galvanize data science/Artificial Intelligence revolution, which will position Nigeria as a leading destination for global projects.





OUR  
VISION

OUR  
PLATFORMS

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ACHIEVEMENTS

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## OUR PLATFORMS

first of its kind  
initiatives built  
from Nigeria

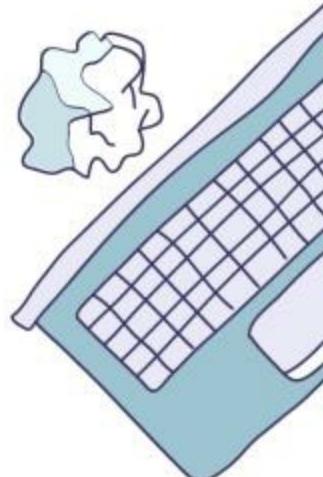


- 1st Intercampus Machine Learning competition
- Artificial Intelligence Bootcamp
- Artificial Intelligence Summer school for students
- Free AI ebooks
- AI+ Knowledge Box
- AI+ Clubs in secondary and universities
- Deep Learning Nigeria
- Artificial Intelligence for Executive
- Artificial Intelligence Hub
- Pan-Nigerian Data Collection apps (text, picture, video and sound)
- AI Invasion - Introductory Machine Learning

...more

### **NIGERIAN CITIES**

- AI+ Researchers Network
- AI+ Professional Meet-Up
- AI Wednesdays
- AI Classes for post-secondary schools
- AgroAI Lab, Yaba, Lagos
- Financial Inclusion Lab, Victoria Island
- AI Masterclass
- Artificial Intelligence Summit
- DataHacks - Hackathon focussed on ir
- Business Analytics Masterclass for Pro
- AI Everyday Free classes
- Pre-University Students AI Classes
- Business Analytics for Professionals
- Data Science Consulting
- Pan Nigeria Data Collection with Data
- Etc



**03**

BUILDING 1 MILLION  
AFRICAN AI TALENT  
IN 10 YEARS:





OUR  
VISION

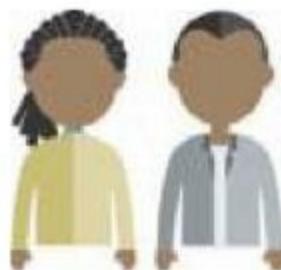
OUR  
PLATFORMS

OUR  
ACHIEVEMENTS

LE

## OUR ACHIEVEMENTS

first of its kind  
initiatives built  
from Nigeria



600,000+

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Starter free ebook to st  
Intelligence through us  
contribution from leadi  
including Prof Yoshua E  
Thomas G. Dietterich ai

10,212

participated in the  
1st ever Intercampus

12,234

online particip  
in Data Scier  
courses – fr

## Machine Learning competition

courses ...  
registration to  
least one cla

300+ direct jobs  
placement,  
project participation  
and internship





OUR  
VISION

OUR  
PLATFORMS

OUR  
ACHIEVEMENTS

LE







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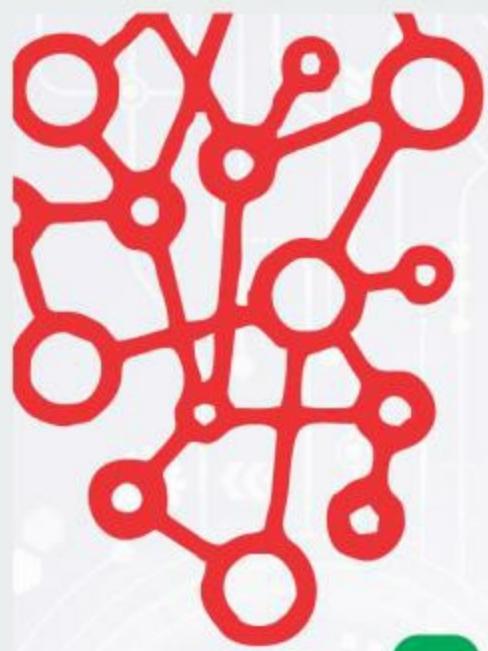
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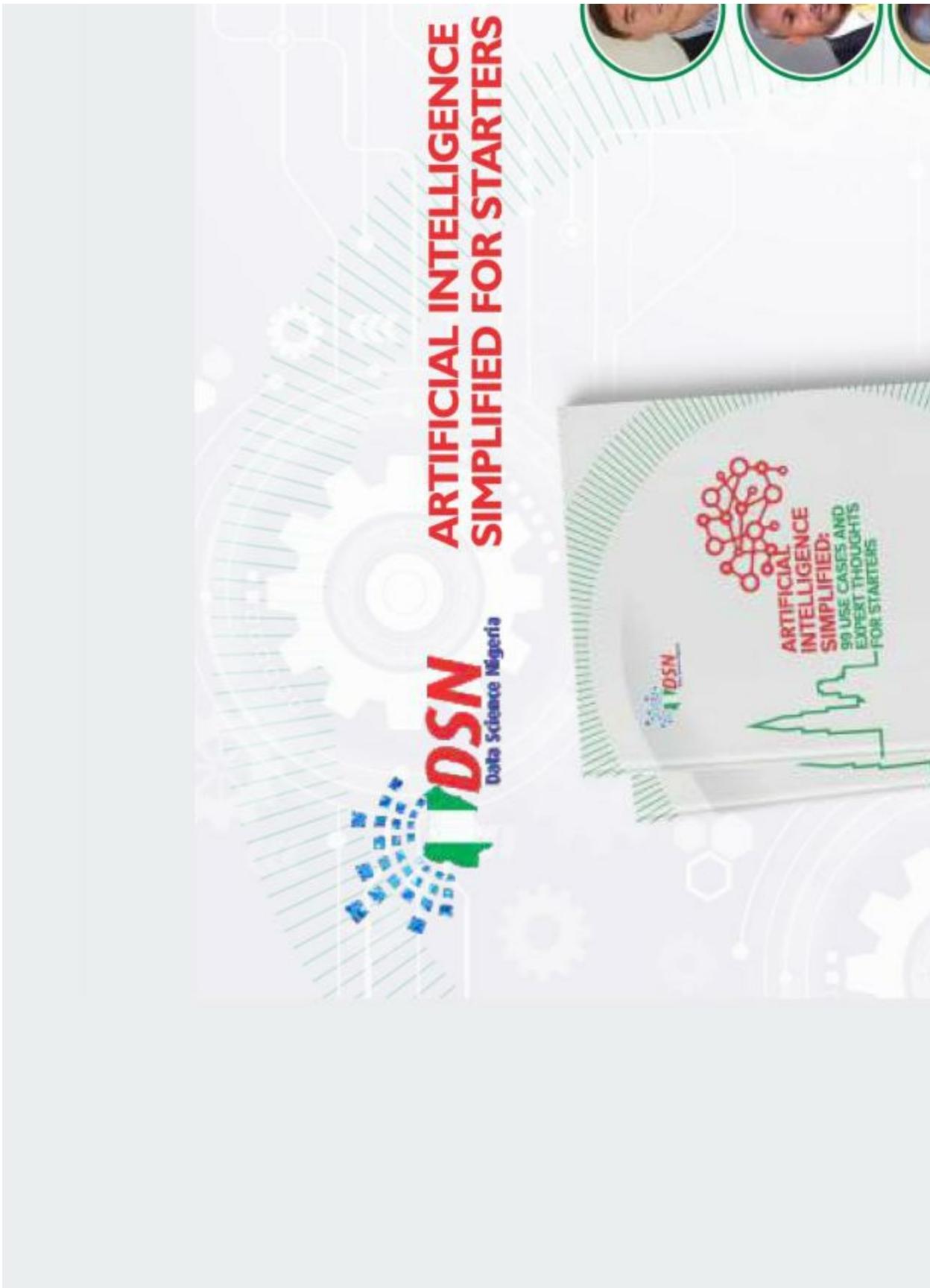






30+ EXPERTS & USERS







## AI Knowledge Box

Effectively bringing world-class AI knowl

On Wednesday 20th of February 2019, Data its artificial intelligence (AI) knowledge box communities in Nigeria and Africa. The AI Ki kind 2-terabyte external hard drives contain educational videos and is part of Data Scien build a world-class Artificial Intelligence (AI learning videos, which has been professional learning platforms of top international Artifi leading global Machine Learning researchers across the world. The selected videos are fre content, which is catalogued based on know specialisation and domain of application.

With this, Nigerian students who want to learn Machine/Deep Learning and other advanced the best learning materials without the challenge of electricity limitation and poor download speed now be well equipped with the most robust the best experts who practice AI in top schools UK and Canada.



---

This effort is in alignment with DSN's roadmap to have one million AI practitioners in 10 years, which will make DSN a top 10 AI talent destination in the world, with major industries.



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20  
INTELLIG  
MAS







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## Contact

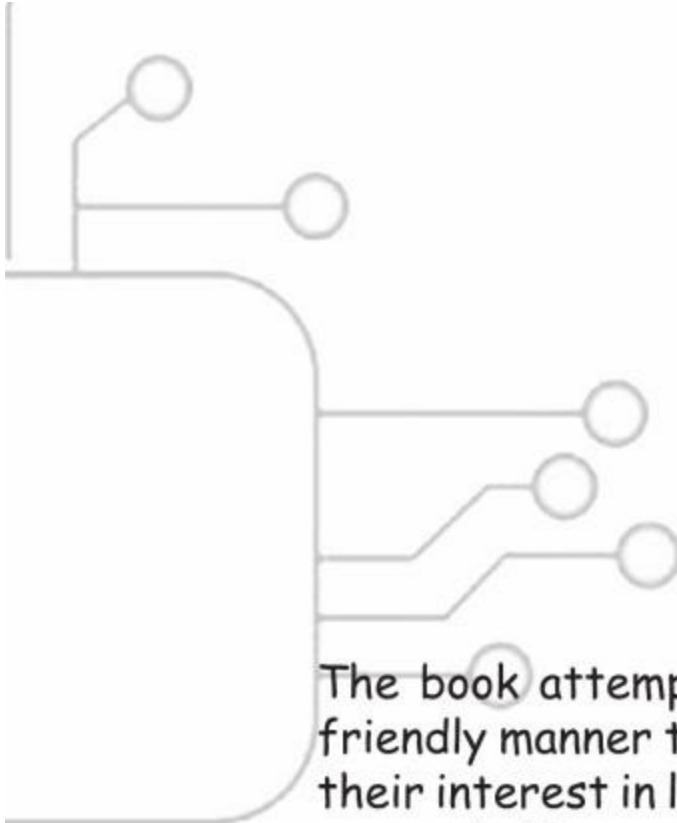
Website: [www.datascienceinc.com](http://www.datascienceinc.com)

Email: [info@datascienceinc.com](mailto:info@datascienceinc.com)

Twitter: [DataScienceInc](#)

**Instagram: Data**  
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**YouTube: https://go**  
**Phone: 0814000**  
**+2348032018**





## ABOUT

The book attempts to demystify the concept of AI in a friendly manner to kids, with the goal of stirring their interest in learning about AI. After the basic concepts like machine learning, deep learning, neural networks, etc., students are guided into step-by-step programs. The intention is to transit beyond the traditional code-first approach and introduce concepts that will sufficiently motivate a desire to learn. Coding skills does not require a university degree; however, the book is designed to teach concepts that will be useful in the future. Like any other language, the sooner you start learning, the better. So, let's get started!

## ABOUT THE AUTHOR



Olubayo Adekanmbi is a leading Data Scientist and Data Science, who comes with over 15 years of experience in two largest tech companies in Africa (IBM and Microsoft) with robust doctoral research.



AI application development.  
first society where Artificial

problems, particularly the sustainable millennial challenges facing Nigerians, and Africans, as a result. He believes Africa has immense opportunities of the fourth industrial revolution to enhance competitiveness in the emerging digital world. He is the founder of Data Science Nigeria, a non-profit foundation, an AI Officer at MTN Nigeria, where he leads enterprise AI projects for sustainable business growth and innovation. Adeboye is the author of two books, *The Future is Shared: The Sharing Economy and the Future of Work* and *Markets and Artificial Intelligence Simplified: 99% Practical Examples*.

